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An Illustrated Magazine

OF

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ON EXCAVATIONS MADE IN ROCKS BY SEA-URCHINS.

BY J. WALTER FEWKES.

THE cavities made by sea-urchins in solid rocks were first described at length by Mr. E. T. Bennett[1] many years ago (1825), and since their discovery the phenomenon has been repeatedly mentioned and discussed. The habit is not confined to any single genus, and it seems capable of proof that the same species does not resort to this practice in all localities in which the animal occurs.

The history of the different opinions in regard to the character of the excavations and the means and object of the boring have been considered by others. It is my purpose to barely refer to the historical part of the subject, or simply mention it without further comment. The question has both a geological and zoological, and likewise a botanical side, as the aid of certain low genera of algæ has been thought necessary to account for the phenomenon.

Leske and Linnæus described a species of Cidaris, *C. saxatilis*, but it does not appear that either of them was familiar with the boring habit of sea-urchins. Rumphius mentions the fact that some sea-urchins are found in holes. Lamarck first gave a

[1] Notice of a Peculiar Property of a Species of Echinus. Trans. Linn. Soc., Vol. XV. p. 74, 7, 1826.

description of *E. lividus*[2] from a specimen taken by Lalande in the neighborhood of Marseilles, and although he does not mention the excavations made by this species, according to Dr. P. Fisher he had in his possession in 1811 a rock excavated by them.

Dr. Fisher[3] in 1864 published an historical account of the observations made by others on this subject up to that year. The additions to our knowledge since that time to the present year have been historically considered in a paper by George John.[4] From these two contributions, as well as from the writings on the subject by Bennett,[5] Cailliaud,[6] Trevelyn,[7] Robert,[8] Lory,[9] Deshayes[10] and Hesse[11] a very good idea of what is known on this subject may be obtained.

The boring habit has been observed in the following rock formations: Chalk, coral limestone, limestone, sandstone, gneiss, granite and lavas. It has also been observed in many other rocks, some of which have not been identified.[12] Excavating sea-urchins have been reported from Ireland, England, the Coasts of France[13] on the English Channel, Bay of Biscay, and Mediterranean, Algiers, Azores, Florida, West Indies, Coast of California,

[2] An attempt by Valenciennes (*Comp. Rend.*, Vol. XLI., p. 743-755) to separate the boring sea-urchin allied to *E. lividus* from the type described from the Mediterranean, under a name *E. tenebrans*, has not been generally followed. The Strongylocentrotus, which makes the excavations at Grand Manan, differs in no way, except possibly that some of the spines are more stumpy, from ordinary specimens which do not bore in rock.

[3] Note sur les perforations de l'*Echinus lividus* Lamk. *Ann. d. Sci. Nat.*, V. Ser., Vol. I. p. 321.

[4] Ueber bohrende Seeigel. *Arch. f. Naturg.*, 55 Jahr, I. Band, 3 Heft.

[5] Notice of a Peculiar Property of a Species of Echinus. Trans. Linn. Soc., 217, 1826.

[6] Observations et nouv. faits sur les Mollusques perforants en general. *Comp. Rend.* t. 39, pp. 43-46. Observations sur les oursins perf. de Bretagne, *Revue et Mag. Zoöl.*, Vol. VIII., pp. 158-179.

[7] Supposed boring powers of the *Echinus lividus*. *Edinb. Philos. Journ.*, 46, pp. 386-87.

[8] Action perforante d'une espece d'Echinoderme. *Comp. Rend.*, t. 39, p. 639.

[9] Observations sur les oursins perforant le granite sur les côtes de la Bretagne. Bull. Soc. Geol., p. 43-46, 1856.

[10] *Ibid.* [11] *Ann. d. Sci. Nat.*, t. VII., p. 251.

[12] John gives a tabular view of the kinds of stone, locality, accompanying organism and observer. made up from his study of the literature.

[13] Fisher has already published a table stating the localities on coasts of France where *Echinus lividus* with excavating habits has been found.

Panama, Australia, Mauritius and Reunion. Not a single instance is recorded from North of Florida on the Atlantic seaboard of North America, with the exception of those from Grand Manan reported in the present paper.

Although it is well known that the sea-urchins of several species are able to excavate holes in solid rock, that habit has not been sufficiently well noted in our common sea-urchin *S. drobachiensis*.[14] It is indirectly referred to in our text-books on Zoölogy, but I have not yet seen a definite statement of a locality on our coast where the excavations can be seen and the boring habit studied. During the past summer (1889) an interesting specimen of rock excavation was observed by the author on the Island of Grand Manan, New Brunswick. A mention of it may not be without value to those interested in this subject or who have in mind a study of the phenomenon. The Black Ledges, which lie near the island of Nantucket, Grand Manan, are rocky reefs bare at low tide and wholly covered at high water. These ledges are made up of a hard mica schist, through which run veins of harder quartzite.[15] These ledges have their surface covered for the most part with "sea weeds" belonging to different kinds of Fuci and Laminariæ, and although not exposed to the full force of the sea from the Bay of Fundy, are still at times beaten by a heavy surf. The sides of the Black Ledges are thus broken or eroded here and there, so that many pools and deep clefts or recesses are forced in them. These recesses are in no way characteristic, but take the form of simple niches in the rock, wholly or partially walled in by the bowlders which lie strewn about, and are often simply natural depressions or basins in the rock. They are generally small, and often have overhanging walls. One of these depressions, which can be visited at low tide only, shows the work of the sea-urchin in rock excavations in the clearest manner. The rock on the sides of which the depressions are

[14] A. Agassiz states (Revision of the Echini, p. 706) that *Strongylocentrotus purpuratus* has this habit on coast of "California." The kind of rock on which the excavation takes place and the name of the observer not given.

[15] This quartzite is found in several places on Grand Manan in such quantities as to impart a white color to the cliffs, and to it may possibly be traced local names, as White Head, given to a well known island lying off the coast.

formed is inclined at a small angle to a perpendicular, and is almost bare of algæ, so that the boring can be seen without difficulty. The basins ordinarily have water in them at low tide. There is no coralline on the floor of the cavity.

The number[16] of sea-urchins at Grand Manan is very great, as was long ago noted by Dr. William Stimpson. In many places it is impossible to see the bottom of the bay, so densely populated is it with these animals. In the rock recess above referred to, the surface of the shelf before the animals were disturbed was paved with sea-urchins, and the number of examples of excavations which they had formed were therefore very numerous. The cavities made by the sea-urchins impart to the rock an appearance not unlike the upper surface of honeycomb, with this difference, that the bounding rim of each excavation is always ring-shaped and entire.

The separate excavations which are shown in the figure, sometimes with the *Strongylocentrotus in situ*, sometimes with the same removed, are never very deep, but are undoubtedly made by the echinoderm. Their surfaces are concave, corresponding with the convexity of the sea-urchin's body, and very smooth, as if freshly cut or worn. They are often larger than the sea-urchin inhabiting them, and roomy enough to admit a free motion of the contained animal. In no instance is the depth of the depression greater than the smaller diameter of the animal. The edge of

[16] The wealth of asteroid and ophiuroid life at Grand Manan is also marvelous to one who has confined his attention to collecting in Massachusetts Bay. The bottom of the passages between the islands would seem to be covered in places with these animals. The dredge near High Duck Island was gorged with specimens of *Ophiopholis aculeata*, with here and there specimens of *Ophiacantha and Ophioglypha*. *Amphiura squamata*, although common, is not found in such multitudes. There is reason to believe from its extreme rarity that the *Comatula* recorded by Stimpson from Grand Manan is a straggler. Certainly the genus is very rare in these waters. *Leptasterias*, *Solaster*, *Crossaster*, and *Hippasterias* were dredged, but they are not common. *Pteraster* also occurs, but is not so frequently found as off Razor Island near Eastport. *Cribrella* is a common Grand Manan genus of starfishes, and a colony of its young, fifty or more in number, were found by M. J. S. Owens on the under side of the rock at low tide near Nantucket. This association in a colonial condition of the young of this genus is an interesting fact, which is probably connected with a want of freedom in earlier stages. *Ctenodiscus crispatus* was not seen by us at Grand Manan, although others have found it there. It was, however, taken at Eastport in subsequent dredging. On the whole the dredging at Grand Manan is not so rich for variety of starfish and ophiuran life as at Easport. The echinoid life is certainly as rich in one place as in another.

the rim which forms a dividing edge between two contiguous excavations is often covered by an incrustation of genera of calcareous algæ.

Prof. W. G. Farlow, of Harvard University, has kindly identified some of the corallines from specimens of the rock submitted to him. He finds upon them, *Lithothamnion polymorphum* (L.) Aresch., and *Melobesia lenormandi* Aresch. A third kind with papillæ, which he interprets as the beginning of branches, he is inclined to regard a young stage of *Lithothamnion fasciculatum*. He writes me that "the corallines of Northern Europe have been more studied since date of his Marine Algæ of New England, and there may be a question whether the nomenclature of our Eastport species should not be modified to adapt itself to recent work in Artic corallines." The most abundant coralline in the neighborhood of the excavation is the first mentioned. From the sections which I have made of alga, and rock, and a minute examination of the line of contact, I cannot see that the former has in anyway modified the surface of the latter, a result practically the same as that arrived at by John in his studies.

While it is possible that this deposit may in some instances augment the depth of the depression, the amount of such increase is not large, for the alga is generally limited to the top of the bounding rim of the depression, and the walls of its deepest part are filed perfectly smooth, while the sides of the depression and more especially the bounding rim are sometimes covered with and augmented by this encrusting coralline. The surface of the hole as above remarked had no coralline, and generally the rock appeared to be freshly cut.

Hesse records an observation of a sea-urchin boring in oyster shells, and regards this habit as a means of getting food. While it is not impossible that a modicum of nourishment may be obtained in this case by the sea-urchin, it seems to the author improbable that the amount thus obtained can be any considerable quantity. I have learned from good authority (Mr. Cheney) that the spiles of weirs at Grand Manan are sometimes excavated by sea-urchins so that the bark of the birch posts is worn through and even depressions made in the wood tissue. In this instance

it may be that the object was food. New observations on this point are necessary, not only as far as the question of excavation in woody fibre is concerned, but also as to the contents of the stomach of those urchins which are found performing this function.

It does not seem to me that the coralline plays any considerable part in the excavation of the rock directly or indirectly, and the sections published by John appear to demonstrate that there is no chemical or other action due to the coralline upon the rock formation upon which it lies. While we would naturally suspect that the geodes[17] once tenanted by urchins might be covered with coralline when deserted by them, in a majority of cases the cavities which are still tenanted have no algous deposit. In those cases where the sea-urchin and the coralline still exist together and in which the surface of the latter is worn by the animal, we may suppose that in the interval during which the sea-urchin had vacated the geode the coralline had taken possession of the cavity, and in due time another sea-urchin had returned to the recess and begun work again upon the layer of calcareous algous formation covering the stone.

My attention was first called to the excavations of Strongylocentrotus by Mr. Webster Cheney, of Nantucket Island, who had discovered them while gunning. Mr. Cheney was not aware, at the time of his discovery, that the fact was known that sea-urchins have their habit of boring in the rocks. I visited the place with a fellow student, Mr. Owens, of Bridgeton, New Jersey.

The following observation was made on the migration of the animal from its excavation, which seems to look as if more than one sea-urchin is concerned in the excavation of a single hole, or that some of the sea-urchins are nestlers as well as borers. It was found, after the sea-urchins had been removed from the excavations which they had made, that in the course of time the holes were repeopled and inhabited by different individuals from those first found there.[18] New individuals thus find the old exca-

[17] The term geode, meaning a cavity, has been used for these excavations. It seems applicable, although used in a somewhat different sense by geologists.

[18] I have, however, no observations to prove that the sea-urchins ever voluntarily leave their cavities for food and after such an excursion return again to them.

vations suited to their purposes, and it is just to conclude that they continue the work of excavation which their predecessors began. They seem to take advantage of the depression already made for their protection.

It may likewise be supposed that in the case of death, natural or violent, an occupation of the former excavation by a new individual may take place. This is possibly true also in the case of boring sea-urchins from the Azores or the coast of France, where very much deeper recesses are sometimes hollowed in the rock. The fact that the sea-urchin is much larger than the entrance by which it entered the cavity, would thus seem to mean, not that the same individual had hollowed out the entire chamber, but that the sea-urchin which now occupies the cavity had grown larger since it passed through the hole excavated by its predecessor.

An interesting question often asked, and as yet unanswered in a satisfactory manner, is, "How do the sea-urchins make these excavations in the solid rock?" This question is a very difficult one to answer, and several attempts have been made to do so satisfactorily. It is not necessary to mention all the theories suggested, but one or two of the more reasonable may be considered.

Robert supposed that the constant motion of the sea-urchin by which the spines act as files after long attrition has worn out these excavations.

It has been suggested by Cailliaud, and this it must be confessed seems a more reasonable explanation, that the cavities are gnawed or chiselled out by the action of the teeth. Both of these explanations seem possible; but the latter is more probable than the former, as several observations seem to point to this conclusion. Among the facts which support Cailliaud's hypothesis are the following: the teeth are very hard, they have means of repair when their tips are worn, and their surface and cutting points are bare, and well adapted for cutting. It may also be added that the muscles which move the jaws are strong. It would seem, so for as their relative hardness goes, that these organs rather than the spines are the tools which have worn out these holes.

The author believes, however, that Robert was partly right for ascribing to the spines a portion of the work done in excavating

the cavities. In sea-urchins taken from rock cavities the spines immediately about the mouth and those on the circumference are somewhat worn in specimens from Grand Manan. Moreover, the surface of the depression is perfectly smoothed in such a symmetrical manner that it seems necessary to suppose a rotary[19] motion of the sea-urchin to effect it. This smoothness, already pointed out in sea-urchin excavations by Trevelyan, could not, I think, have resulted from the teeth alone.

The major part of the work in the excavation of rock by sea-urchins must, however, fall upon the teeth and the dental apparatus. Upon this point the writings of Cailliaud are conclusive. These teeth are probable chisels, which pry into the rock or gouge out fragments, and in that way eventually remove considerable quantities of rock from its bed. A. Agassiz adopts the theory that sea-urchin excavations are chiseled out by the teeth, but offers no evidence bearing on Cailliaud's theory.

John has, it seems to me, furnished important data, indicating that the teeth play a part in the wearing out of the rock cavities in which the urchins live, for he was able to find in the alimentary canal of the sea-urchin fragments of stone similar to that in which the borings were made. The simple fact, however, that grains of rock similar to those of the locality of the sea-urchin are found, is not in itself an evidence that they were chiseled out of the rock by the teeth. We know that toothless Echinoidea, as for instance genera of Spatangoids, often have their alimentary canal full of sand, which has apparently been swallowed by the animal. There seems no reason to refuse to believe that any of the so-called round sea-urchins are not able to swallow small pebbles in the same way, but while it is true that the one (spatangoid) generally lives on the sand, and the other (echinoid) on rocky bottom, one can readily see how small fragments might be picked up by the latter and swallowed.[20]

[19] This rotary motion is yet to be observed, but it may be said that if it exists it must be very slow, as the animals never move rapidly.

[20] Sea-urchins are at times scavengers, or at all events a carcass of a seal sunk in the water will be found to be covered with these animals. Possibly they feed on the sea fleas and other animals which do the work of scavengers.

We have members of almost all the lower groups of animals, as sponges, annelids and other worms, mollusks and crustaceans, all of which are endowed with boring habits. The excavating habit possessed by the sea-urchin may belong to the same category as that of these animals, and it may be a voluntary act for self protection or other purposes. There is, however, this very interesting fact pointed out by others in relation to the boring sea-urchin, in which it seems to differ from those already mentioned. The habit of excavating seems to be one which is limited to individual sea-urchins which live in certain exposed positions, where the tides are very high. Thousands of specimens of sea-urchins on rocks where there was not a visible sign of excavating can be found, and those echinoderms which are below the wash of the tide, as well as some in its force, exhibit no manifestation of this power. These facts lead me to ask if it is not possible that there are influences in environment or in physical forces acting upon them which make certain individuals an involuntary agent in boring. Or is it not probable that we may find the excavating power due in part to the action of the sea itself. It is in other words possible that the force which excavates these geodes is somewhat similar to that exerted in the case of the formation of the geologic phenomenon known as "pot-holes." The living body of the sea-urchin might occupy the same relation to the cavity in which it lies that the inert stone does to the pot-hole in which it is often found, and which it played an essential part in creating. The fact that beautiful examples of pot-holes can be seen worn out of the solid rock on the adjoining island of Grand Manan, not far from the sea-urchin excavations, has suggested this explanation, which certainly has much to recommend it. We may, if we adopt this theory as a part of the explanation, regard the echinoid body clothed with its spines as an involuntary agent moved about by the waves, slightly perhaps, yet moved enough to wear out by its attrition in course of time the solid substance of the rock. The spines, teeth, and possibly the body itself may thus exert a wearing action capable in time of making an excavation into the solid rock. This explanation would furnish good reason for the very

smooth character of the floor of many of the sea-urchin hollows.

One can readily imagine how in the beginning of the growth of the cavity, in order to cling more tenaciously to the rock, the sea-urchin seeks out a small natural depression in which it anchors itself by its suckers for protection from the surf. Constant movement of its body, due to the waves, and consequent attrition of the spines and teeth, caused by the movement of the water, deepens this slight depression until it reaches a considerable size, which is enlarged by every motion of the animal. To this increase in size voluntary movements of teeth and spines also contribute.[21]

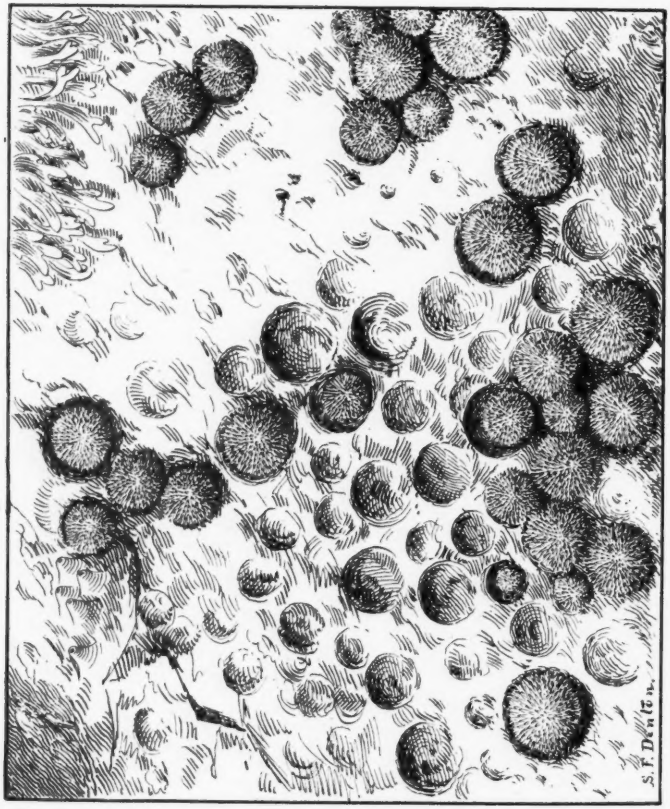
The accompanying figure taken from a photograph by Mr. Northrop, of the School of Mines, New York, represents a number of these sea-urchins as they naturally lie in their excavations, and also several cavities, formerly occupied, from which the inhabitants have been removed. Although these holes are not so deep and therefore not so conspicuous as can be seen in rocks from some other coasts which might be introduced in illustration, they are the only ones which I have ever seen from our vicinity which exhibit this phenomenon.[22]

I am tempted to return to an aspect of the subject to which I have already alluded. Notwithstanding the large numbers of sea-urchins found at Grand Manan, the places where the excavating habit can be studied are very few in number and very local. I know indeed of no other locality except on the Black Ledges where there are excavations of this kind, and yet there are many places where the conditions are identical, and where the animals are equally abundant. It may be concluded from these facts that there must be certain peculiarities of environment especially adapted to these animals to present favorable conditions in individuals for this habit. It would seem that a mechanical explanation that the depressions were in a way due to forces analogous to the action of those at work in the excavation of "pot-holes"

[21] James Salter. On the Structure and Growth of the Teeth of Echinus. *Quart. Journ. Micr. Sc.*, 1861, p. 216.

[22] The fact that specimens illustrating the excavating power of the sea-urchins can be seen on our coast is an interesting one as affording an opportunity to study the method by which the sea-urchins accomplish their work.

PLATE I.



BURROWING ECHINI.

The above figure was taken from a photograph of a part of the side of the grotto in which the sea-urchins are found. The photograph was kindly taken for me by Professor Northop of the School of Mines, New York City, to whom I am indebted for this and other kindnesses.—(*See page 10.*)

affords in a way a harmonious explanation of the extreme rarity of these excavations on the coast of an island densely populated by sea-urchins. There seems no satisfactory reason why, if the process of excavating is simply a habit, we should find it so rarely exhibited. It is true that some species of mollusks sometimes excavate and sometimes do not, but while it is not improbable that there are many localities on our coast where specimens to illustrate this process may be found, they are certainly not as numerous as we might justly suspect they might be if the power of excavating was a voluntary one alone, and not in some way connected with forces acting about them. It likewise seems as if, knowing as we do that the habit of boring in rocks is found in those animals where the process is wholly voluntary, we might ascribe the habit in sea-urchins to the animal itself. We are at a loss to explain why sea-urchins make excavations only when they are in certain places and under certain conditions.

This peculiarity has already been noted by Deshayes in regard to *Echinus* (*Strongylocentrotus*) *lividus* on the two shores of France, and needs a further study.[23]

Dr. George Dimmock informs me that he has seen these excavations at Banyuls-sur-Mer. As these excavations exist on the shore of the Mediterranean, the suggestion that the excavations are limited to rocks beaten by a heavy surf or where there is a large tide would seem to be unsupported. Still, in a general way, the excavations made by sea-urchins are greater and more numerous on coasts beaten by a strong sea, and where there is a considerable tidal variation.

A theory that the work of excavation is in part assisted by acid secretions from organs of the body, feet, or mouth, does not seem plausible, or at all events requires more decisive observations than have yet been brought to its aid. The excavations are in all kinds of rock, and it seems improbable that a secretion could be made by them which would act on lava, limestone, slate and granite. The same may be said also of the

[23] According to Fisher, Lalande found them near Marseilles, while Arthur Eloffe, Marcel de Serres and Cailliaud have observed or recorded sea-urchins in holes near the lighthouse of Planier, also on the Mediterranean.

supposed power of the suckers of the ambulacral feet or the other soft structures of the body. Until more facts are advanced in support of these theories we can hardly accept them as well founded.

Either the calcareous spines, the wall of the test, or, most important of all, the teeth are singly or together the agents which have produced these excavations. It seems to the author plausible that mechanical movements of the sea-urchin by the waves, in combination with voluntary action, has played some part in the formation of these cavities. It might facilitate our framing a satisfactory answer to the question if we knew whether or not the matter worn off from the surface of the sea-urchin excavations was always passed into the alimentary canal. An examination of the stomachs of sea-urchins which inhabit these excavations might by following John's method throw light on this question. Unfortunately I have nothing to add to what is already known bearing on this subject.

An interesting example of erosion and the excavating habit of the sea-urchins has been called to my attention by Prof. Jules Marcou, of Cambridge. At my request Professor Marcou has kindly written out his notes, which have never been published, and are consequently quoted entire in the following pages:

"PERFORATIONS DU CALCAIRE SABLEUX NUMMULITIQUE INFÉRIEUR PAR L' *Echinus lividus* DANS LES ROCHES DE HALDE À BIARRITZ.

"Entre le vieux Port de Biarritz et la côte des Basques, s' advance la Pointe des Roches de Halde, toujours très fortement battue par les vagues; à basse marée l' extrémité de la Pointe se découvre sur une longeur moyenne de 75 pieds anglais (25 metres); et au milieu d'algues diverses on trouve tout une population littorale (Moules, Patelles, Littorines, Actinies et surtout des Oursins). L'oursin est l'espéce commune tout le long de la côte de l'Atlantique, *Echinus lividus* Lam.; non seulement cet oursin se creuse une niche dans laquelle il vit, mais bien plus il agit en corps pour se créer une habitation collective.

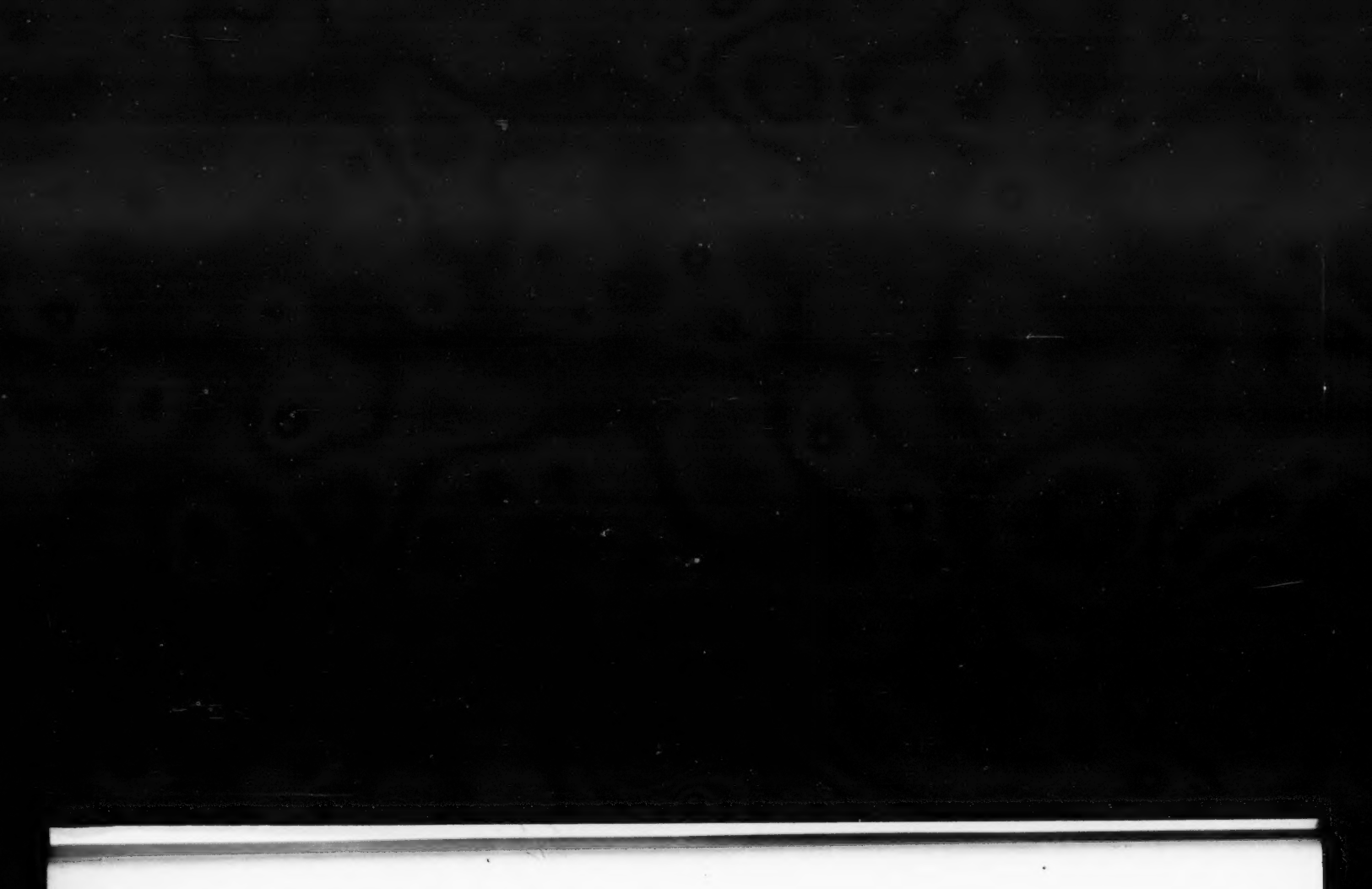
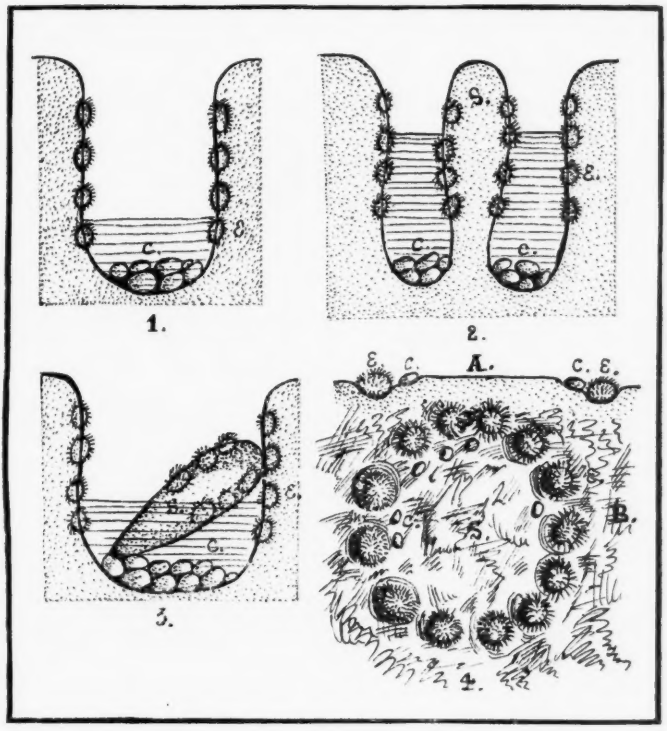


PLATE II.



DIAGRAMS OF SEA-URCHIN EXCAVATIONS AT BIARRITZ,

(JULES MARCOU, DEL.)

A few words in explanation of the diagram may lead to a better comprehension of them. Fig. 1 represents a pot-hole partially filled with water, on the walls of which sea-urchins (*e*), can be seen; at the bottom of the pot-hole there are small stones (*c*); the breadth of these pot-holes is indicated by Professor Marcou as one and one-half feet, the depth, two feet. Fig. 2 shows a stylated pot-hole; and Fig 3, a pot-hole in which the style (*s*) is broken off and appears as a stone, somewhat larger than the other (*c*). On the large stone the sea-urchins can be seen clinging in their canties. Fig. 4 has two parts: *A*, which shows a section of the rock on which, when seen from above, the sea-urchins are arranged in a ring. These sea-urchins are sunk in depressions, while centripetally to them appear the small stones, (*c*), which are supposed to form the annular depression about the style (*s*); *B* of Fig. 4 represents the ring of sea-urchins on the surface of the rock, seen from above.—(*See page 13.*)

" On voit dans le calcaire sableux des espèces de marmite ou de mortier, tous habités par cet oursin, et dont voici les divers états, lorsque je les ai observé, à la marée basse le 8 mai, 1876.

" Tout à fait à l'extrémité des Roches de Halde, là où l'eau reste dans les anfractuosités, les depressions et les marmites, au milieu d'algues très épaisses; on rencontre:

" 1. [25] Des trous ayant de un pied, à deux pieds de profondeur au maximum, et de un pied à un pied et demi de diametre, en forme de marmite; au fond on voit des cailloux trés arondis et usés, qui à chaque marée sont fortement agités par les mouvement violent de l'eau, qui déferle toujours avec une grande force sur toute la Pointe de Halde et recoivent ainsi un mouvement circulaire, qui les fait creuser de plus en plus la marmite où ils se trouvent. Chacune de ces marmites est occupée par plusieurs rangs d'oursins, étagés les uns au dessous des autres, sur trois, quatre, ou cinq ligues; et chaque oursin occupe une niche de deux a quatre centimetres de profondeur, qu'il a creusé lui-même avec ses piquants dont il se sert comme d' une lime.

" 2. La marmite ou mortier a quelquefois au milieu une colonne solide de calcaire.

" 3. La colonne du milieu fini par être usée à son pied par le mouvement continuel de rotation des cailloux accumulés au fond de la marmite et j'en ai vu un example avec la colonne detacheé et gisant comme un pilon au fond d'un mortier, comme la figure ci-joint. Les echinus sur la colonne isolée et qui agissait alors en tournant comme les autres cailloux roulés, étaient vivants et ne paraissaient pas être incommodés par le mouvement de rotation auquel ils étaient soumis, deux fois par 24 heures.

" 4. Enfin j'ai vu un commencement de marmite. Des oursins s'étaient placés sur un espèce de cercle et y avaient creusés leurs niches; quelque petits cailloux detachés commençaient leur office de creusement du calcaire pour arriver à créer une station-marmite pour les échinides.

[25] Each of the above-mentioned conditions is illustrated by a diagram bearing the same number. These diagrams are copied from drawings which Prof. Marcou has kindly made and sent to me, and convey very well the peculiarity of these remarkable excavations.

"Comme aspect chacune de ces marmites avec sa population de 40 à 60 Echinus, et peut-être plus, resemble à une façade de maison avec un habitant à chaque fenêtre ouverte et qui seraient occupés à regarder ce qui se passe. Tous les échinides étaient bien portants, et je n'en ai pas vu de mort.

"JULES MARCOU."

According to Fisher, Cailliaud says that excavations by sea-urchins were observed at Biarritz by MM. Sæmann and Cazenavette. This was probably the first observation of this habit in this locality, but I am unable to discover from Cailliaud's account that the peculiar relation to pot-holes was noticed by them, or by any author quoted by him in the preparation of his paper.

It is remarkable that such an interesting case of erosion should have escaped their observation, a fact which may be ascribed possibly to the inaccessible position in which these rock erosions were to be found. Marcou was engaged in collecting fossils when the pot-holes were discovered, which led him to portions of the coast not easily visited.[26]

Fisher also observed that the common sea-urchin at Biarritz has the habit of excavating, although the relation of these urchins to pot-holes in that locality seems to have escaped his notice. He writes: "A marée basse une grande partie des rochers du Port-Vieux sont émergés et rejoinnent quelques blocs plus élevés, placés au large, qu'il serait facile de relier par une jetée. La mer bat vigoureusement contre des roches plus résistantes que les falaises de la côte des Basques; le sol du port est un sable très-fin. . . . Quand on examine les rochers á marée basse, on trouve au-dessous de la ligne d'émergence des excavation sprofondes, de grandeur variable, depassant quelquefois un mètre carré en superficie. Jamais ces excavations ne manquent d'eau, lors même que leur contour émerge à l'epoque des grandes marées; leur profondeur permet á la mer d'y laisser au moins un

[26] At the time of his visit Prof. Marcou was not specially engaged in a study of the work of these animals, but the examples of rock erosion were so striking that his attention was attracted to them, and he retains to-day thirteen years after his visit, a vivid memory of them. On his return to America he called the attention of several persons to his observation, but nothing was published, and apparently no great interest was excited in them.

décimetre d'eau. C'est dans ces sortes de cuvettes que vivent les oursins (*Echinus lividus*, Lamk.) parqués par groupes de vingt-cinq á cent disposés dans un ordre admirable, possédant moins un trou; leurs excavations sont tellement rapprochées, qu'il est impossible à d'autres oursins de conquérir une place dans la colonne.

"La position des oursins est invariable; la bouche reste appliquée en bas, au centre du trou; l'anus est par conséquent en haut. A l'époque de mes observations (août, 1863), les oursins gardaient une immobilité compléte, les radioles étant redressées; ils s'engageaient si bien dans les excavations, que souvent leur extraction m'en a paru impossible.

"Je n'ai pas aperçu d'oursins sur des roches émergées et privées d'eau; et partout où j'en ai trouvé, ils étaient logés dans des trous particuliers."

From the above quotation, which is but a part of the description which Dr. Fisher gives of the work of sea-urchins at Biarritz, it is evident that he carefully studied these excavations at this point, but neither from this description nor from the remainder of his account am I able to find that the peculiar relation observed by Marcou between sea-urchins and pot-holes was seen. He makes a minute comparison with the perforations found at Biarritz of a number of specimens, which at the time of his writing existed in the Museum d'histoire Naturelle at Paris.

It may not be out of place to call attention to certain peculiarities in sea-urchin excavations suggested by Prof. Marcou's notes. From the observations it seems that veritable "pot-holes" were found at Biarritz in which there is a central column of rock, which is unlike in its relationship to the pot-hole to the columella to the cup of certain corals. This central axis or style he supposes to be formed by the wearing away of the rock about it, by which it is left standing as a pinnacle.[27]

Prof. Marcou believes that the first stage of development of the ring-shaped stylated pot-hole is due to the sea-urchins exca-

[27] It is of course necessary to know whether this pinnacle is of the same rock as that which bounds the "pot-holes," and not a concretionary structure. Prof. Marcou has furnished the desired information, for he says that the style is of the same kind of rock as that in which the pot-hole is worn.

vating in a ring-shaped depression (Fig. 4, A. and B.) enclosing the central area. The animals are assisted in their work by the presence of small stones (*c*), which have been washed in by the waves. An interesting observation in relation to the sea-urchins is that on the inner surface of the pot-hole there are many small excavations worn by the sea-urchins (*e*). Each sea-urchin is lodged in a cavity which it has worn out. Moreover, there are also similar holes (Fig. 2) excavated by the sea-urchins with the animals still in them on the central style. The Echinoids occupied their supplementary excavations when they were seen by Prof. Marcou, and the cavities are so shallow that a small part of the body of the sea-urchin projects beyond the level of the rim of the hole. The position is certainly exceptional, but not less remarkable than the fact that we have a pot-hole with a central columella.[28] Prof. Marcou also observed "pot-holes," and the surfaces of the enclosed stone (*s*) were tenanted with sea-urchins which were found in slight depressions. The size of the enclosed stones would seem to imply that they are due to a breaking away at the base of the central style of the first kind, and not that they were the active agents in wearing down the inner surface of the pot-hole.

The first type (Fig. 1) of pot-holes with sea-urchins, which were observed by Prof. Marcou, may be nothing more or less than ordinary "pot-holes" in which the wearing stone is found at the bottom. They are interesting as possessing supplementary cavities worn in the sides by the sea-urchins. This type may have been either derived from the third (Fig. 3), that with a larger enclosed stone, which itself came from the stylated (Fig. 2), or it may have been developed, as in the case of ordinary pot-holes which do not have the stylated axis, by simple grinding resulting from the movement of the stone. It can readily be seen that the third instance (Fig. 3) mentioned by him is derived from the second (Fig. 2), and that the second may have been derived from the fourth. The first, however, may have been formed as all simple pot-holes, by the rocks or pebbles within it, as ordi-

[28] It certainly cannot be supposed that the pot-holes with a central pinnacle of this kind are formed in the same way as ordinary kinds.

narily explained by geologists. It may, of course, have been formed from the third by repeated grinding of the rock without the sea-urchin contributing any help.

The statement that the sea-urchins are arranged in stories is an interesting one. I am unaware that a similar arrangement has ever before been observed, and I have never seen similar examples of the arrangement of sea-urchins in a ring, as observed by Prof. Marcou, and described by him in the fourth instance (B, Fig. 4).

The wearing away of the zone of rock, leaving the central axis (*s*) standing, is certainly a remarkable case of erosion, unlike any which has been recorded.

The explanation advanced to explain the central style is certainly an ingenious one, and should be investigated by those naturalists who visit Biarritz. The hypothesis that the sea-urchins bore in the solid rock a ring of excavations, the walls of which were broken down by the small "cailloux" (*c*), seems plausible, but why the sea-urchins should arrange themselves in a ring (B, Fig. 4) is not wholly clear to me. It is a well known fact that sea-urchins have a habit of getting together bits of sticks, algæ shell, etc., by which they cover themselves. Those that live on sandy sea bottom, as our common clypeastroid Echinarachnius, crawl under the sand in order to hide themselves. [29] The boring sea-urchin possibly collects the stones for this purpose, which,

[29] I have observed on the Florida Reef an interesting case of the inclusion of an Echinoderm by the growth of coral about it. This phenomenon is not a rare one as far as other animals of various groups are concerned, but there is reason to believe that the inclusion of an Echinoderm by growing coral is not common. At all events I am not familiar with a printed record of this fact. The inclusion takes place by a simple growth of the cœnosarc around the urchin, leaving the animal in a cyst, which is in free communication with the external water through a small opening. This imprisonment of a sea-urchin by a growth of coral cœnosarc is in its results not unlike the excavating habit of the sea-urchin, and may have been mistaken for it. The conditions, however, are readily distinguished from each other, and the process by which both are brought about is radically different. In both instances we probably have a means of protection of the animal from the waves. I am informed by Mr. C. H. Maynard that sea-urchin excavations on the Bahamas are tenanted by a genus of Chitons. This mollusk may not be a commensalist, only so far as to seek the protection of the hole from the surf. Mr. Maynard likewise finds a small fish inhabits these sea-urchin excavations, and he tells me that when alarmed the fish hides among the spines or under the body of the sea-urchin. This is a phenomenon somewhat like the habit of hiding under stones which has long been known in Lepadogaster and the "butterfish," and other fishes, and can hardly be interpreted as an instance of commensalism.

dropping off, fall down between the sea-urchins, and by their grinding action serve to enlarge the depression. The stones, however, are too large to be placed there by the sea-urchins, and it is probable that they were simply caught in the depression after having been thrown there by the waves.

Prof. Marcou has furnished the following directions for those who would examine the interesting pot-holes which he has discovered at Biarritz:

South of "le port Vieux" there push out to the west into the sea at least three peninsulas, separated by parallel bays. The road to the Côte de Basques runs at the base of these peninsulas, on the eastern edge. The pot-holes were observed at the western end of the most western of these peninsulas. The locality is rich in fossil echinoidea, serpulæ, and other animals.

The question of why and how the sea-urchins bore in the rock seem to have been answered in as many ways as the number of observers. The sea-urchin excavations at Grand Manan have certain resemblances to and differ somewhat from those recorded by others. My interpretation of their cause, as derived from their study at this locality, also differs somewhat from those of other observers. As to the question why the sea-urchins make these hollows there seems at least two answers. Their main object is probably for protection from the waves, as has already been shown by several naturalists. At the same time that the depressions serve for protection, they would form receptacles for water, which would be of great use to the animal between tides.[30] Ordinarily not much water would be retained in that way, but in the case of the pot-holes at Biarritz it would be considerable in amount, and natural aquaria with a continual supply of pure water would be at hand. Prof. Marcou has aptly compared the situation of these colonies of sea-urchins on the walls of a pot-hole to a hotel with guests. The simile, though fanciful, may not be far from the truth. It is a significant fact that sea-urchin excavations where the tides are small, as in the Mediterranean, are also not very large.

[30] Marcel de Serres (Sur l'action perforante de l'*Echinus lividus*. *Comp. Rend.*, Vol. XVIII., pp. 405, 406) tries to explain the rarity of sea-urchins' excavations on the coast of the Mediterranean by the absence of the ebb and flow of the tide.

The almost universal presence of a calcareous alga on the rim of the sea-urchin boring might seem to indicate that there is a symbiosis between the alga and the animal. It would seem as if the rim was built up, in part at least, by the alga, as a protection for the sea-urchin, and that in return the alga received certain advantages. In the case of very deep sea-urchin excavations this would not hold, as there can be no doubt that the cavity is made by the urchin boring in the rock.[31]

Among other statements which might well be quoted, Caillaud reaches the following conclusion, which is very significant Speaking of rock excavations, and of the buccal armature, he asks, "S'il n'était pas dans la nature de ces êtres de creuser des roches, pourquoi seraient-ils ainsi pourvus et outillés de poinçons en émail dont les sommités s'usent, puis se renouvellent, se cracourcissent dès lors et doivent, de toute nécessité, recevoir le prolongement nécessaire pour conserver leur longueur voulue tant que l'oursin travaille? Si cet appareil," he continues, "si bien combiné pour agir sur la pierre n'avait pas ce but, il deviendrait inutile à cette tribu de veritables Echinus que en sont pourvus ; ils auraient reçu des simples dents fixes et ordinaires, comme tant d'autres dans cette immense famille, comptant, comme nous l'avons dit, en vivants et fossiles, seize cents espèces. Comme example, nous citerons particulièrement le genre Clypéaster, à qui tous les moyens de perforer les roches sont interdits."

It is interesting, taken in connection with the above quotation, to speculate as to the character and use of the "Aristotle's Lantern" in the Clypeastroids, and its absence in the Spatangoids. The lantern of the genus Echinarachnius is so small and inconspicuous that it is difficult to believe that its function is the same as in the round sea-urchins, or echinoids. Moreover the manner of life of this genus is such that we can hardly suppose that there

[31] Deshayes does not accept the view that the sea-urchin bores in the rock. He regards them as simply seeking out excavations already existing. He finds first that it is without example elsewhere in the animal world that the same species on one coast bores holes, and on another does not. Secondly, the habit once acquired would be universal for individuals of the same species. Thirdly, the sea-urchins have no organ for boring, and, lastly, the holes are covered with calcareous algæ. These views have been discussed by others. I think, in answer to the first and second objections, we may say that the wave motion brings it about that individuals in one place bore, and in another do not.

is any need of a complicated buccal apparatus such as is found in Strongylocentrotus. One is even tempted to regard the lantern in Echinarachnius as a rudimentary organ which has lost its functional importance.[32]

While it is next to impossible to say how much or how little of the excavation is due to any one of the three means of wearing away of the rock, the teeth, spines, and wave action, we can safely conclude that the most important factor in this work is the dental apparatus. Next in importance are possibly the spines, while last of all comes that work done by the rolling about of the sea-urchin due to the motion of the water. To the general proposition advanced by John, we might also add that there is evidence that the time which has elapsed between the inception of the sea-urchin's work in excavation and the present condition of the cavities is probably much larger than the life of the individual which now occupies it. In an interval between two occupants the interregnum may have been filled out by effective grinding out of the cavity by the motions of the test of the former occupant, or by fragments of the spine, the teeth, or other hard parts of the dead animal which has left this heritage as a means when moved by the water to grind out the excavation for its successor.

After a somewhat extended discussion of the views of others, John gives as his conclusions in regard to sea-urchin excavations the following summary:

"Die in den Gesteinen gefundenen und von Seeigeln bewohnten Höhlen rühren von diesen selbst her. Der Echinus erzeugt seine Wohnstätten mittelst seines Kauapparates und sekundär mit Hilfe der Stacheln durch rotierende Bewegung. Er bohrt sich solche Höhlungen, um einen Schutz gegen das brandende Meer zu haben.

"Die Kalkalgen, welche die von Seeigeln bewohnten Gesteine bedecken, lagern sich mechanisch auf das Gestein und haben

[32] It seems to the writer capable of proof that the flat sea-urchins are structurally lower as far as their internal anatomy goes than the so-called "round sea-urchins." Still that proposition would not be accepted by one or two prominent special students of these animals, and this does not seem the place to present arguments in its support, or to combat objections which might readily be made to it.

keinen Einfluss auf die chemische Beschaffenheit der Oberfläche desselben, kömmen daher auch nicht mit dem Entstehen der Echinushöhlen in Zusammenhang gebracht werden."

The above conclusions are substantially those to which the author has been led by a study of the sea-urchin excavations at Grand Manan, except that he would also adduce the motion of the sea as an additional factor in the excavation of these cavities. By this wave action the sea-urchin covered with spines is moved about, rubbing against the wall of the cavity in which it rests. A continued action of the spines and other hard parts of the animal on the rock thus deepens the depression at the same time that it files the surface smooth.

SUMMARY.

The results of the preceding pages may be briefly stated as follows:

1. *Strongylocentrotus drobachiensis* on the coast of Grand Manan sometimes makes excavations in solid rock.

2. The excavations are made by the sea-urchin by means of its teeth, spines, combined with motions of the animal produced by waves and tide. The object is primarily for protection, but secondarily a sufficient amount of water is in that way retained by the animal during half tide, or when otherwise uncovered.

3. The coralline accompanying the sea-urchin, generally found at the rim of the excavation, takes no part in the formation of the recess, although its presence may be necessary to the animal for some unknown reason.

3. Sea-urchins are found at Biarritz, France, which live in stories on the walls of peculiar pot-holes, some of which have a central style also tenanted by the same animals in small depressions.

5. The sea-urchins play some part in the formation of stylated pot-holes, although they are assisted by the movements of stones, produced by the action of tides and waves.

Boston, January 1st, 1890.

INSTANCES OF THE EFFECTS OF MUSICAL SOUNDS ON ANIMALS.

BY ROBERT E. C. STEARNS.

SOME years ago I observed in a casual way the effect of musical sounds upon certain animals, and was inclined to pursue the inquiry and endeavor to learn by careful experiment through the medium of music how far or in what degree there might exist between man and certain animals that fellow-feeling which makes the whole world kin.

The fraternal relation between dog and man, whether the latter be civilized or savage, is too well known to require remark. So, too, with other animals which man has domesticated, notably the horse and cat.

Some four or five years ago, at a meeting of the Biological Section of the British Association, Sir John Lubbock read some interesting notes on the intelligence of the dog. The man and the dog he said, have lived together in more or less intimate association for many thousands of years, and yet it must be confessed that they know comparatively little of one another. That the dog is a loyal, true, and affectionate friend must be gratefully admitted, but when we come to consider the psychical nature of the animal, the limits of our knowledge are almost immediately reached. I have elsewhere suggested that this arises very much from the fact that hitherto we have tried to teach animals rather than to learn from them—to convey our ideas to them rather than to devise any language or code of signals by which they might communicate theirs to us.

So it occurred to me that we might learn something of the animals around and about us,—add somewhat to the stock of knowledge, and get many interesting hints, some useful and some curious, as to their inner nature,—by the aid of music or musical sounds, by observing the effect of such sounds upon them.

In pursuing an investigation of this kind, we would naturally experiment with the domesticated animals *first*, and of such animals those with which we are the most intimate. Thus the dog and cat are household pets; in many cases housemates from birth to death. Generations of these animals are born within the social atmosphere of the same human family, and quite likely derive or receive through heredity, as well as by individual contact or experience, a feeling or sense of security, protection and fraternity.

While such animals may be regarded perhaps as becoming, though such contact, somewhat humanized, and therefore less adapted or satisfactory for the purposes of such experiments, on the other hand their familiarity with a great number of sounds which their untrained brethren know nothing of would seem to be fully an off-set, and again their familiarity with man would operate adversely to a feeling of fear when experimental sounds were being made.

We do not know that any influence analagous to music inspires the military ants in their great marches, or that the monœcious snails have any occasion for love songs. But these are not next of kin in the scale of Nature, and we have poor relations nearer home who seem to be moved by the same or similar impulses with ourselves.

By voice or sounds fully as much as by facial expression or gesture—movement of body or limb—the emotions are expressed by the human animal, and this is in great measure the case among the animals which follow along after or below man. The moods and tenses of feeling, pleasure and pain, joys and sorrows, are made apparent by the intonation of the voice, by the sounds which such conditions induce, provoke or compel.

We speak of the sense of hearing. An inquiry of the kind herein suggested, relates to the sense of sounds.

The sense of sounds among the higher animals we may assume to be nearly universal, and among dogs and some other animals, combined with memory, tends to the development of the intellectual quality, as the sense of hearing in a certain aspect is an intellectual rather than a physical sense.

To what degree this sense of sounds is developed or exists, can be learned only by experiment, and requires on the part of the experimenter what I unfortunately do not possess,—a knowledge of music, and the ability to play upon one or more instruments.

The sense of sounds, we may assume, varies in animals below man as it does in man, or as the color sense varies; often limited, or nearly or quite wanting; hence the term color-blindness, and we may use the term sound-deafness in an analagous way.

The experiments of Lubbock referred to show a great difference in the perceptions and receptivity of dogs, as between his black poodle "Van" and Mrs. Lubbock's collie "Patience." In speaking of it Sir John says, "I was rather disappointed at this, as if it had succeeded the plan would have opened out many interesting lines of inquiry. Still, in such a case one ought not to wish for one result more than another, as of course the object of all such experiments is merely to elicit the truth, and our result in the present case, though negative, is very interesting."

To the terms music and musical sounds, in this connection, an exceedingly liberal definition must be conceded,—liberal in a simple and non-technical sense, so as to include:

1. Sounds not even musical, but occurring in simple rhythmic order or succession, like the common marching drum-taps, when the full military band is resting.

2. Melodious sounds, or sounds in themselves musical, occurring in harmonious sequence.

3. The same in various strains or keys, more or less complex, but combined and arranged in accordance with harmony.

Of these definitions the first will oftenest serve the purpose.

It would seem that in the selection of tunes or sounds for experimental use, a hint may be had from the animals by observing the special sounds uttered by them in their various moods.

With the birds, for instance, a tune or sounds which include the notes uttered in their amorous moods at or about mating-time.

Many of the sounds which by man are regarded as musical and agreeable may not produce an agreeable impression upon animals, but may have an annoying effect upon them, as the monotonous, attenuated and irritating hum of the mosquito, the filing of a saw, or the riveting of a steam boiler, with its rasping and tumultuous clangor, have upon us.

I spoke of sounds that are regarded as musical by man, but here comes to mind a wide chasm in the way of difference between the musical sense or taste of the European or Caucasian, and the Chinese or Mongolian, idea of music and musical sounds, whether vocal or instrumental.

Some time ago there appeared in a New York paper an account of an interview with an Englishman residing in that city, who, it was stated, had a mania for collecting and taming various small animals, lizards, snakes, spiders, etc.

The question was asked, "How do you manage the taming process?" Answer.—"It was simple enough. First of all I tried kindness. By kindness I mean warmth and music, and as much food as the animals could possibly eat, so as to get them in to a state of torpor. If they were not well advanced in amiability in a week the music was stopped altogether, and I gave but little food. This made them savage. They then had music occasionally, the doses increasing in proportion to the improvement in their temper."

Question.—"What kind of music did you give them?"

Answer.—"It varied a great deal. Some of them liked a piano best. Some liked a violin, and others a flute, and one was never so happy as when listening to an Æolian harp I had erected on the window of the room I kept them in. They all liked a musical box. You might not believe it, but there was not a single one of my snakes or lizards that could not distinguish instruments and tunes. They had very good taste and ear, and would keep time to slow measured music by wagging their heads, and if I ever created discord when playing they would get quite in a rage. I remember a thunderstorm angered them once, and I could hardly keep them from attacking one another, and indulging in a free fight. Luckily an itinerant German band was

within hail, and I prevailed upon its members by financial arguments to play to those beasts for an hour. They were pacified, but the neighbors for two hundred yards around were not."

While conceding a liberal margin for the embellishment of the interviewer and the enthusiasm of the interviewed, there is no doubt that the leaven of the fact prevails in the foregoing. The statement as to the wagging of heads, however, may safely be disregarded.

Without further preamble or speculation, in proceeding with the data which are here brought together, we will begin with the domestic animals, and first with the dogs,—"dogs of high and low degree."

DOGS AND MUSIC.

Goodrich relates many interesting anecdotes on the apparent effect of music on various animals, among which I find this:

"A dog in Paris, at the commencement of the Revolution, was know to musicians by the name of 'Parade,' because he regularly attended the military at the Tuilleries, stood by and marched with the band. At night he went to the Opera, and dined with any musician who intimated, by word or gesture, that his company was asked, yet always withdrew from any attempt to make him the property of any individual."

Mr. W. S. Jones states that he has "a Skye terrier about four months old who, when the piano is played, seems to be curiously fascinated by the sound, and comes toward it, but then howls in a most plaintive way with his nose in the air, as if protesting against the sound."

C. J. W. says, "a black-and-tan terrier that we kept for some time was particularly sensitive to music. Although scales played on the piano made her yell piteously, it was by the concertina's sweet influences that she was most affected, flying before it, and, if unable to leave the room, whining until the tune was stopped. A Spitzbergen dog-friend of ours is much excited by music, but when one tune is played its excitement is more marked;—the

tune is, 'Bonny Dundee.' Dogs are not peculiar in their feeling for music: witness the fact that retired cavalry horses obey the call of the bugle when accidentally heard."

To the Rev. Mr. James of Tuscarora, Nevada, I am indebted for the following and other pertinent instances:

"In Eureka, Nevada, I visited in a family who were the proud possessors of a dog named 'Ben.' Ben was one of those smart dogs who knew everything. He was passionately fond of piano music; it silenced the wagging of his tail, and the studious look of the eyes, as you sat at the instrument, denoted pleasure; but no sooner would the harmonica (mouth organ) be played than he would howl and give short yelps in a ferocious style. The music of the ordinary organ affected him in the same way."

An old friend, Prof. George Davidson, of California, has kindly furnished me with many interesting items, among which the following relate to dogs:

"A small black-and-tan named 'Bessie,' belonging to Mr. A. B. Corson, of North Fifth Street, Philadelphia, will, on hearing 'Shall we meet beyond the River?' sung, throw her head back and set up a most dismal howl, while the tears will run down her cheeks. If the tune is played solemnly on an organ and no word spoken, the same thing will occur; but if any of the words are spoken, with not the slightest musical intonation, she will run to the speaker, and beg and plead in her own way, and do everything but speak, to have it stopped."

"'Toodles,' a Spitz, belonging to the same person, will howl when a discord occurs, or when an accordeon is played, but is not otherwise affected; while 'Rose,' another Spitz, will lie at the foot of the organ, apparently pleased with the music, but making no demonstration of either pleasure or annoyance."

"A black-and-tan, rather larger, named 'Duke,' belonging to Mr. Loney, of North Sixth Street, Philadelphia, will, on hearing 'Hold the Fort' sung, start in with the rest, and will actually sing in dog fashion as long as the singing goes on, and appears to be delighted with the music."

"A Spitz which belonged to Mr. Charles Wetherald (formerly of North Sixth Street, but now of Bryn Mawr), named 'Blanco,'

was so affected by the music of a violin that he would howl, and if the music was persisted in would fly at the musician, and one or the other would have to leave."

DOGS AND CHURCH-BELLS.

"Living next door to us in our English home was the sexton of a church, in the belfry of which was a beautiful peal of eight bells. Each Sunday morning and evening before service the sexton, as leader of the bell ringers, would go to the belfry (the church stood exactly opposite his house) to perform his duties. He had a large Newfoundland dog, which—no sooner did he perceive the sexton going out—would take his stand just outside the door of his master's house, and immediately the bells began to ring would raise his head and howl in the most melancholy and profound manner. No speaking to him would change his position; he would go on until the ringing ceased."

A Salem, Illinois, dog has been reported as similarly affected by the sound of church bells, and, it would seem, by Presbyterian in particular:

"Conrad Bollinger for some years past was the owner of two dogs which were much attached to each other. Several months since one of them died, and the effect thereby produced on the one living was very marked. It for days acted strange, as if lost; and when the bell of the Cumberland Presbyterian Church rang it set up a doleful noise. This it does at each ringing of the bell, during which time it will gaze intently up at the belfry. If the ringing is not protracted it keeps up the whining, howling noise, and when done it returns to the house, which is near to the church. None of the other bells seem to affect this dog."

HOUNDS AND THE BUGLE.

In Mrs. Custer's entertaining volume, "Boots and Saddles," she mentions the effect of the Cavalry Bugle-call as follows: "The pack of hounds were an endless source of delight to the general. We had about forty; the staghounds, that run by sight,

and are, on the whole, the fleetest and most enduring dogs in the world, and the fox-hounds, that follow the trail with their noses close to the ground. The first rarely bark, but the latter are very noisy. The general and I used to listen with amusement to their attempts to strike the key note of the bugler when he sounded the calls summoning the men to guard, mount, stables, or retreat. It rather destroyed the military effect to see beside his soldierly figure a hound sitting down absorbed in imitation. With lifted head and rolling eyes there issued from the broad mouth notes so doleful they would have answered for a *misericordia.*

During a period of ill health I boarded for several months at a hotel in Auburn, California, and a part of nearly every day was passed in the shade of a vine-clad summer house, on the neighboring grounds of an acquaintance, Dr. Todd. A friend of mine, a young man in poor health, boarded with the Doctor, and we were together every day.

Doctor Todd had an old collie that served the purpose of a watch-dog. Our relations with the animal were such that it knew us to be friendly; during the day the dog was always with us. Without the slightest look, word, or sign of command, rebuke or menace by either of us, the moment I commenced to imitate a French horn he would immediately leave and skulk away to his kennel, evidently very much annoyed, and that too without regard to the tune. When a veritable horn was played upon by my companion the poor dog trembled in every limb, went to his kennel, and remained there in a state of nervous agitation, made neither a bark, howl or moan, but wore a deplorably pitiable expression, as if his nerves were absolutely unstrung. No doubt the sounds affected him as the filing of a saw or Chinese instrumental music affect me.

(*To be continued.*)

THE HISTORY OF GARDEN VEGETABLES.

BY E. L. STURTEVANT.

(Continued from p. 677, Vol. XXIII., 1889.)

NASTURTIUM. *Tropæolum* sp.

IT is rather as ornamental flower-garden plants that the nasturtiums are now so universally grown. Yet they are also classed among kitchen-garden esculents, the flower-buds and the seeds serving, when pickled, as a caper substitute, and the flowers used for garnishing. In 1683 Worlidge,[1] in England, says, "from a Flower are now become an acceptable Sallad, as well as the blossom." In 1690 Quintyne[2] grew them in the royal kitchen-gardens of France. Both species were received in Europe in the 16th century, as will be seen from the appended synonymies. Both are found wild in Peru.

Tropæolum minus L.

This species seems to have been first known in Europe about 1574, described by Monardes;[3] it is figured by Lobel[4] in 1576, and is generally spoken of about this period as a new and rare plant. It was in the vegetable-garden in England, in 1726,[5] probably before, and is mentioned in American gardens in 1806.[6] The synonymy appears as below:

Nasturtii Indici genuina effigies. Lob. Obs., 1576, 338, cum ic.

Nasturtium peregrinum, myconii. Lugd., 1587, 656, cum ic.

Flos sanguineus. Lugd., 1587, 1918.

Nasturtium Indicum. Lob. ic, 1591, 616; Dod., 1616, 397, cum ic.

Mastuorzo. Cast. Dur., 1617, 277, cum ic.

Pelon mexixquiletl, seu nasturtio Peruino. Hern., 1651, 161, cum ic.

Cardamindum minus et vulgare. Feuille, Peru, 1725, III., t. 8.

[1] Syst. Hort. By J. W. Gent., 1683, 216.
[2] Quintyne. Comp. Gard., 1693, 189.
[3] Hort. Eyst., 1713, ord. 13, fol. 1.
[4] Lobel. Obs., 1576, 338.
[5] Townsend. Seedsman, 1726, 40.
[6] McMahon. Am. Gard. Cal., 1806.

Tropæolum majus L.

"The seeds of this rare and faire plant came first from the Indies into Spaine and those hot regions, and from thence into France and Flanders, from whence I have received seeds that hath borne with me both flowers and seede," says Gerarde in 1597.[7] We cannot agree with those authors who consider this the dwarf form, as the figure given comes nearer to the Tall, as it was figured by J. Bauhin,[8] in his works printed in 1651, with the name *scandens*, thirty-three years before its asserted introduction by Linnæus. Ray,[9] in 1686, speaks of its use as a vegetable, and this use is also spoken of by Townsend[5] in 1726. In American gardens it was noticed by McMahon[6] in 1806, and by all the early garden writers, as being the predominant kind in culture.

The synonymy I offer is shorter than the preceding:

Nasturtium Indicum. Cam. ic., 1588, t. 31.

Nasturtium Indicum. Indian cresses. Ger., 1597, 196.

Nasturtium indicum folio peltato scandens. J. Bauh., 1651, II., 75.

Cardamindum ampliore folio and majore flore. Feuille, Peru, 1725, III., t. 8.

The *nasturtium* or *Indian cress*,[7] or *capucin capers*,[2] with the epithet Tall or Dwarf, is called in France, *capucine, cresson du Mexique, fleur de sang, fleur sanguine, cresson de Peru, cresson d'Inde;* in Germany, *kapuciner kresse, Indianische kresse;* in Flanders and Holland, *capucine kers;* in Italy, *nasturzio, astuzzia;* in Spain, *capuchina;* in Portugal, *chagas;*[10] in Norway, *blomkarse;*[11] in Arabic, *tortour el-bachah.*[12]

Tropæolum tuberosus R. et P.

In Bolivia this plant is extensively cultivated in the high mountain districts, for its tubers, which are considered a delicacy, and are highly esteemed. It does not seem to have entered European or American culture, although it is retained by Vil-

[7] Gerarde. Herb., 1597, 196; 1633, 251.
[8] J. Bauhin. Hist., 1651, II., 75.
[9] Ray. Hist., 1686, 487.
[10] Vilmorin. Les Pl. Pot., 56.
[11] Schubeler. Cult. Pfl. de Norw., 118.
[12] Delile. Fl. Ægypt, Ill.

morin among garden esculents.[10] It was described in 1794, and was carried to France in 1836,[13] but its tubers were not found palatable to European taste.[14] The tubers are of good size, and are marked with purple upon a yellowish ground.

The tuberous-rooted nasturtium is called in France *capucine tubereuse;* in Germany, *Peruanische knollenkresse;* in Flanders, *knoll-kapucien;* in Spain, *capuchina tuberculosa;*[10] in Peru, *mayna*,[15] *massua;* in Bolivia, *isano*,[13] *ysano*,[16] in Mexico, *ysano*, or *taiacha*.[13]

NEW ZEALAND SPINAGE. *Tetragonia expansa*, Ait.

This plant was first found by Sir Joseph Banks, in 1770, at Queen Charlotte's Sound, New Zealand, and its merits discovered to the sailors of Captain Cook's expedition round the world. It reached Kew gardens in 1772.[17] It also occurs in Australia, both on the coast and in the desert interior, in New Caledonia, China, Japan, and Chili.[18] Don[17] says three varieties are found in Chili, one with smooth leaves, one with leaves hoary beneath, and a third small and glabrous. It was cultivated as a spinage plant in England in 1821 or earlier.[17] It was in use in France in 1824 or earlier.[19] In the United States its seed was distributed among members of the New York Horticultural Society in 1827, and in 1828 it appeared in our seed catalogues.[20] St. Hilaire[21] records its use as a spinage in South Brazil, and Bojer[22] in the Mauritius.

The New Zealand spinage is called in France *tetragone, cornue, tetragone etalee, epinard de la nouvelle-zelande;* in Germany, *neuseelandischer spinat;* in Flanders, *vierhouk, vierkant-vrugt;* in Denmark, *myseelandsk spinat;* in Italy, *tetragona*,[23] in the Mauritius, *tetragone*,[22] in Japan, *tsuri na*, i.e., creeping cabbage.[24]

[13] Heuze. Les Pl. Alim., II., 546.
[14] Bon Jard., 1882, 435.
[15] Kunth. Syn., II., 256.
[16] Jour. Hort. Soc., IX., 59.
[17] Don. Gard. and Bot. Dict., III., 152.
[18] Mueller. Sel. Pl., 1876, 237.
[19] Pirolle. L'Hort. Fran., 1824-5, 256.
[20] Thorburn's Cat., 1828, 88.
[21] St. Hilaire. Fl. Br. Merid., 1824.
[22] Bojer. Hort. Maur., 1837, 155.
[23] Vilmorin. Les Pl. Pot., 1883, 552.
[24] Thunberg. Japan, 1784, 208.

NIGHTSHADE. *Solanum nigrum* L.

This plant, says Vilmorin, is not as yet used in France as a vegetable, but in warm countries the leaves are sometimes eaten as spinage.[25] It is mentioned by Galen[26] among aliments in the second century, but was not cultivated in Germany in Fuchsius,[27] time, 1542, although it retained its name, *Solanum hortense*, perhaps from its former cultivation. It is a plant of a wide distribution, occurring in the northern hemisphere from Sweden, and the north-east of America from Hudson Bay, even to the equatorial regions, as for example at Timor, the Galapagos, the Antilles, Abyssinia, the Mascarene Isles, Mauritius, Van Diemen's Land, Chili, etc.[28] It is found as a pot herb in the markets of Mauritus,[29] and is used as a spinage in Central Africa.[30] In China the young shoots are eaten, as also its black berries,[31] and in the Mississippi Valley the little black berries are made into pies and other pastry.[32]

The *Nightshade* or *black nightshade* is called in France, *morelle noire, M. de l'ile de France, M. commune, brede, creve-chien, herbe aux magiciens, morette, raisin de loup;* in Germany, *verbesseter nachschatten spinat;* in Italy, *erba mora;* in Spain, *yerba mora*.[33]

OKRA. *Hibiscus esculentus* L.

The Spanish Moors appear to have been well acquainted with this plant, which was known to them by the name of *bamiyah*. Abul-Abbas el-Nebati, a native of Seville, learned in plants, who visited Egypt A. D. 1216, describes in unmistakable terms the form of the plant, its seeds and fruit, which last, he remarks, is eaten when young and tender with meal by the Egyptians.[34] The references to this plant in the earlier botanies are not numerous, and the synonymies offered are often incorrect. I think the following, however, are justified:

[25] Vilmorin. The Veg. Gard., 355.
[26] Galen. De Alim., Lib. 2, Bruns. edition, 1547, 153.
[27] Fuchsius. De Stirp., 1542, 69.
[28] Decandolle. Geog. Bot., 573.
[29] Seemann. Gard. Chron., 1861, 622.
[30] Grant. Speke's Nile, 576.
[31] Smith. Mat. Med. of Ch., 201.
[32] Bessey. Bot., 502.
[33] Vilmorin. Les Pl. Pot., 354.
[34] Pharmacographia, 1879, 94.

Trionum theophrasti. Rauwolf, in Ap. to Lugd., 1587, 31, cum ic.

Alcea ægyptia. Clusius, Hist., 1601, 2, 27, cum ic.

Honorius bellus. In Clus., l.c., 2, 311.

Bamia alessandrina. Cast. Dur., 1617, Ap., cum ic.

Quingombo. Marcg. Bras., 1648, 31, cum ic.; Piso., Bras., 1658, 211, cum ic.

Malva rosea sive hortensis. J. Bauhin, 1651, II., 951.

Ketmia americana annua flore albo, fructu non sulcato longissimo. Comelyn, Hort. Med., Amstelod, 1701, 150, cum ic.

Of these the last only, that of Comelyn, represents the type of pod of the varieties usually to be found in our gardens, but plants are occasionally to be found bearing pods which resemble those figured in the above list. I find little recorded, however, concerning variety, as in the regions where its culture is particularly affected there is a paucity of writers. Miller's Dictionary, 1807, mentions that there are different forms of pods in different varieties; in some not thicker than a man's finger, and five or six inches long; in others very thick, and not more than two or three inches long; in some erect; in others rather inclined. Lunan,[35] in Jamaica, in 1814, speaks of the pods being of different size and form in the varieties. In 1831 Don[36] describes a species, the *H. bammia*, Link., with very long pods. In 1863 Burr[37] describes four varieties in American gardens, two dwarfs, one pendant-podded, and one tall and white-podded. In 1885, at the New York Agricultural Experiment Station, varieties were grown under eleven different names, and from these we were able to satisfy ourselves of three distinct sorts only. Vilmorin[38] in 1885 names but two sorts, the long-fruited and the round-fruited.

Its culture is now recorded in nearly all the tropical countries, and it reached Brazil before 1648, as recorded by Marcgravius. It is recorded in gardens about Philadelphia in 1748,[39] in Virginia in 1781,[40] and in general garden culture in 1806.[41]

[35] Lunan. Jam., 1814, II., 12.

[36] Don. Gard. and Bot. Dict., I., 480.

[37] Burr. Field and Gard. Veg., 614.

[38] Vilmorin. The Veg. Gard., 1885, 356.

[39] Kalm. Trav., I., 74.

[40] Jefferson's Notes.

[41] McMahon. Am. Gard. Cal., 1806.

Okra, ocra, or *gombo,* in India *ochro* and *gobbo*[42] is called in France *gombo, gombaud, ketmie comestible, calalon, quiabo, quingombo, okra;* in Italy, *ibisco;* in Spain, *gombo;*[43] in Greece, *vamies;*[44] in Brazil, *quingombo, quiabo;*[45] in the Mauritius, *lalo;*[46] in Curaçoa, *gigambo.*[51]

In Arabic, *bamyeh toneyly, i.e., bamia* with long fruit,[47] *bamia, bamia schami, bamia stambouli, rumi;*[48] in Angola, *quillobo;*[49] in Bengali, *ramturay, dhenroos;*[50] in Burma, *yung-ma-dae;*[44] in Central Africa, *bameea;*[51] in Congo, *quingombo* or *quigombo;*[49] in Egypt, *bamia,*[44] *chama;*[52] in Hindustani, *ram-turai, bhinde;*[50] in India, *dhenroos, ramturee, bhindee;*[53] in Malabar, *vendah;*[50] in Nubia, *djyoundou;*[44] in Persia, *bamiyah;*[51] in Tamil, *venda, venday;* in Telegu, *benda.*[50]

OLLUCO. *Ullucus tuberosus* Lozano.

Although Vilmorin says the culture of this plant has not given good results in France, yet he includes it in his book on vegetables. It was brought into French culture in 1848 by the Minister of Agriculture.[54] It is cultivated in the Andes of Peru, Bolivia and New Granada, Chili and Mexico.[55] The tubers are yellow, very smooth, starchy, and are developed on runners proceeding from the base of the stem.[56] Lieut. Herndon,[57] who ate them in Peru, pronounced them more glutinous than the *oca* and not so pleasant to the taste.

The *olluco* is called at Quito *ulluco* or *melloco;*[58] in Peru, *ulluca;*[57] in the Andes of Peru and Bolivia, *oca quina;*[59] in Chili, *melloes* and *ulloco;* in Mexico, *papa lissa.*[55]

Acosta,[60] in speaking of the food plants of Colao, Peru, where the climate is cold and dry, says, "The Indians use an other

[42] Firminger. Gard. in Ind., 141.
[43] Vilmorin. Les Pl. Pot., 242.
[44] Pickering. Ch. Hist., 274.
[45] St. Hilaire. Fl. Bras. Merid.
[46] Bojer. Hort. Maurit., 30.
[47] Delile. Fl. Æg. Ill.
[48] Forskal. Fl. Æg. Arab., c. XVII., 125.
[49] Piso. De Ind., 1658, 211; Marcg. Bras., 1648, 31.
[50] Drury. Useful Pl. of Ind., 1.
[51] Pharmacographia, 94.
[52] Gard. Chron., 1882, Oct. 7, 458.
[53] Speede. Ind. Handb. of Gard., 1842, 180.
[54] Decaisne & Naudin. Man., IV., 106.
[55] Heuze. Les Pl. Alim., II., 545.
[56] Herndon. Amazon, 52.
[57] Gard. Chron., 1848, 828, 862.
[58] Don. Gard. and Bot. Dict.
[59] Treas. of Bot.
[60] Acosta. Hist. of the Ind., 1604, 259.

kinde of roote, which they call *Papas;* these rootes are like to grownd nuttes, they are small rootes, which cast out many leaves. They gather this *Papas*, and dry it well in the Sunne, then beating it they make that which they call *Chuno*, which keepes many daies, and serves for bread. In this realme there is great trafficke of *Chuno*, the which they carry to the mines of Potozi; they likewise eat of these *Papas* boyled or roasted. There is one sweete of these kindes, which grows in hot places, whereof they do make certaine sawces and minced meats, which they call *Locro*."

As the *olluco* is said by Heuze to be only eaten raw, outside of Mexico, we may believe that Acosta refers in this extract to this plant, the potato and the sweet potato.

ONION. *Allium cepa* L.

The culture of the onion was known at a remote period, and in the ancient Egyptian paintings a priest is frequently seen holding them in his hand, or covering an altar with a bundle of thin leaves and roots.[61] Hippocrates[62] mentions that they are commonly eaten 430 B.C. Theophrastus,[63] 322 B.C., names a number of varieties, the Sardian, the Cnidian, Thamocracian, and the Setanicon, all named from the places of growth. Those of Issus and Sardis are white. Dioscorides,[64] 60 A.D., speaks of the onion as long or round; yellow or white. Columella,[65] 42 A.D., speaks of the Marsicam, which the country people call *unionem*, and this word seems to be the origin of our word *onion*, the French *ognon*. Pliny,[66] A.D. 79, devotes considerable space to the *cepa*, and says the round onion is the best, and that the red are more highly flavored than the white. Palladius,[67] 210 A.D., gives minute directions for culture. Apicius,[68] A.D. 230, gives a number of recipes for the use of the onion in cookery, but its uses by this epicurean writer are rather as a seasoner than as an edible. In

[61] Wilkinson. Ancient Egyptians, I., 168.
[62] Hippocrates. Opera, Camerarius ed., Paris, 1546, 113.
[63] Theophrastus. Bodæus ed., 1644, 761, 785.
[64] Dioscorides. Ruel ed., 1529, 135.
[65] Columella. Lib. XII., c. 10.
[66] Pliny. Lib. XIX., c. 32.
[67] Palladius. Lib. III., c. 24.
[68] Apicius. De Opsoniis, etc. Amsterdam, 1709.

the thirteenth century Albertus Magnus[69] describes the onion, but does not include it in his list of garden plants where he speaks of the leek and garlic, by which we would infer, what indeed seems to have been the case with the ancients, that it was in less esteem than these now minor vegetables. In the sixteenth century Amatus Lusitanus[70] says the onion is one of the commonest of vegetables, and occurs in red and white varieties, and of various qualities, some sweet, others strong, and yet others intermediate in savor. In 1570, Matthiolus[71] refers to varieties as large and small, long, round and flat, red, bluish, green and white. Laurembergius,[72] in 1632, says onions differ in form, some being round, others oblong; in color, some white, others dark red; in size, some being large, others small; from their origin, as German, Danish, Spanish, etc. He says the Roman colonies during the reign of Agrippa grew in the gardens of the monasteries a Russian sort, which attained sometimes the weight of eight pounds. He calls the *Spanish* onion oblong, white and large, excelling all other sorts in sweetness and size, and grown in large abundance in Holland. At Rome the sort which brings the highest price in the markets is the *Caieta;* at Amsterdam the *St. Omer.*

At the present time Vilmorin[73] describes sixty varieties, and there are a number of varieties grown which are not noted by him in France. In form these may be described as flat, flattened, disc-form, spherical, spherical-flattened, pear-shaped, long. This last form seems to attain an exaggerated length in Japan, where I have been told that they often equal a foot in length. In 1886, Kizo Tamari,[74] a Japanese commissioner to this country, says, "Our onions have not large globular bulbs. They are grown just like celery in this country, and have long, white, slender stalks." In addition to the forms mentioned above we rank the *top onion* and the potato onion among our varieties. The onion is described in many colors, such as white, dull white, silvery white, pearly white, yellowish green, coppery yellow, salmon yel-

[69] Albertus Magnus. De Veg., Jessen ed., 1867, 487.
[70] Amatus Lusitanus. In Diosc., 1554, 273.
[71] Matthiolus. Com., 1570, 389.
[72] Laurembergius. Apparat. Plant., 1632, 27.
[73] Vilmorin. Les Pl. Pot., 1883.
[74] Am. Hort., Sept., 1886, 10.

low, greenish yellow, bright yellow, pale salmon, salmon pink, coppery pink, chamois, red, bright red, blood red, dark red, purplish.

But few of our modern forms are noticed in the early botanies. The following synonymy includes all I have noted, but in establishing it it must be noted that many of the figures upon which it is founded are quite indistinct.

I. Bulb flat at bottom; tapering towards stem.

Cepa. Fuchsius, 1542, 430.
Cepa rotunda. Bodæus, 1644, 787.
Cæpe sive Cepa rubra et alba. J. Bauhin, 1651, II., 549.
Geant de Rocca. Vilm., 1883, 387.
Mammoth Pompeii. American Seedsmen.
Golden Queen. American Seedsmen.
Paris Silverskin. American Seedsmen.
Silver White Etna. American Seedsmen.

The difference at first sight between the crude figure of Fuchsius and the modern varieties is great, but ordinary experience indicates that the changes are no greater than can be observed under selection.

II. Bulb round at bottom; tapering towards stem.

Zwiblen. Roszlin, 1550, 121.
Cepa. Tragus, 1552, 737.
Cæpa. Cam. Epit., 1586, 324.
Blanc hatif de Valence. Vil., 1883, 378.
Neapolitan Marzajola. American Seedsmen.
Round White Silverskin. American Seedsmen.
White Portugal. American Seedsmen.

III. Bulb roundish, flattened above and below.

Cepa. Matth., 1558, 276; Pin., 1561, 215.
Cæpa capitata. Matth., 1570, 388.
Cepe. Lob. Obs., 1576, 73; ic., 1591, I., 150.
Cepa rubra. Ger., 1597, 134.
Cepa rotunda. Dod., 1616, 687.
Rouge gros-plat d'Italie. Vilm., 1883, 387.

Bermuda. American Seedsmen.
Large Flat Madeira. American Seedsmen.
Wethersfield Large Red. American Seedsmen.

IV. Bulb rounded below, flattened above.

De cepis. Pictorius, 1581, 82.
Philadelphia Yellow Dutch or Strasburg. American Seedsmen.

V. Bulb spherical, or nearly so.

Cepa. Tragus, 1552, 737. Lauremb., 1632, 26.
Cepe. Lob. Obs., 1576, 73; ic., 1591, I., 150.
Cepe alba. Ger., 1597, 134.
Cæpa capitata. Matth., 1598, 419.
Jaune de Danvers. Vilm., 1883, 380.
Danvers. American Seedsmen.

VI. Bulb dishing on the bottom.

Cepa rotunda. Bodæus, 1644, 786.
Extra Early Red. American Seedsmen.

VII. Bulb oblong.

Cæpa. Cam. Epit., 1586, 324.
Cepea Hispanica oblonga. Lob. ic., 1591, I., 150.
Cepa oblonga. Dod., 1616, 687; Bodæus, 1644, 787.
Piriform. Vilm., 1883, 388.

VIII. The top onion.

In 1557 Dalechamp[75] records with great surprise an onion plant which bore in the place of seed, small bulbs.

The onion was named by Chaucer,[76] in England, about 1340. In Mexico *onyons* are mentioned by Peter Martyr[77] before 1557, in Peru before 1604,[78] in New England about 1629,[79] in Virginia in 1648,[80] and were among the Indian foods destroyed by General Sullivan[81] in western New York in 1779. In 1806 McMahon[82] records eight varieties in American gardens.

[75] Hist. Gen., 1587, 532.
[76] Chaucer. Prologue, V., 636.
[77] Eden. Hist. of Trav., 1577.
[78] Acosta. Hist. of the Ind., 1604, 261.
[79] Wood. New Eng. Prosp., 1st ed., II.
[80] A Perf. Desc. of Va., 1649, 4.
[81] Conover. Early Hist. of Geneva, 47.
[82] McMahon. Am. Gard. Cal., 1806.

The onion is called in France, *ognon, oignon;* in Germany, *Zwibel;* in Flanders, *ajuin;* in Holland, *uijen;* in Denmark, *rodlog;* in Italy, *cipolla;* in Spain, *cebolla;* in Portugal, *cebola*;[83] in the Mauritius, *oignon;*[84] in Norway, *rodlog;*[85] in Greek, *krommuon;* in Latin, *cepa.*

In Arabic, *bussul*,[86] *basal;*[87] in Bengali, *pulantoo, peeaj;*[88] in Ceylon, *loono;*[86] in China, *tsum xi;* in Cochin China, *cay hanh;*[89] in Hindustani, *pee-aj;*[86] in India, *peeaj;*[90] in Japan, *soo, fitmosi;*[91] in Java, *brangbang;*[86] in Malay, *bawangmera;*[88] in Persia, *peeaj;*[86] in Sanscrit, *palandu, latarka,*[88] *sukandaka*;[86] in Tamil, *venggayum;* in Telegu, *wolliguidda.*[88]

ORACH. *Atriplex hortensis* L.

This spinach plant is grown as a vegetable, and also to use as a salad, mixed with sorrel in order to correct the acidity. It was known to the ancient Greeks and Romans, and it seems to have been used more in the early times before the introduction of the spinach than now. Two varieties are known; the red and the green, each with a sub-variety of a paler color. It was known to Turner[92] in England in 1538, who calls it *areche*, or *red oreche.* In 1686 Ray[93] mentions the white and the red, even as mentioned by Gerarde[94] in 1597. In 1623 Bauhin[95] mentions the red, the white, and the dark green. In 1806, three kinds are named by McMahon[96] as in American gardens.

Orach, orache, French spinach, or *Mountain spinach* is called in France, *arroche, armol, arrode, arrouse, belle dame, bonne dame, eripe, erode, follette, iribe, irible, prudefemme;* in Germany, *gartenmelde;* in Flanders and Holland, *melde, hofmelde;* in Italy, *atreplice;* in Spain, *armuelle;* in Portugal, *armolas;*[97] in Nor-

[83] Vilmorin. Les Pl. Pot., 374.
[84] Bojer. Hort. Maur., 1837, 347.
[85] Schubeler. Culturpflanz, 53.
[86] Ainslie. Mat. Med., I., 269.
[87] Delile. Fl. Ægypt, Ill.
[88] Birdwood. Veg. Prod. of Bomb., 186.
[89] Loureiro. Fl. Cochin Ch., 201.
[90] Speede. Ind. Handb. of Gard., 156.
[91] Kæmpfer. Amoen, 830; Thunb. Jap., 132.
[92] Turner. Libellus, 1538.
[93] Ray. Hist., 1686, 191.
[94] Gerarde. Herb., 1597, 256.
[95] Bauhin. Pinax, 1623, 119.
[96] McMahon. American Gar. Cal., 1806.
[97] Vilmorin. Les Pl. Pot., 13.

wegian, *havemelde*;[98] in Greece, *vlita, spanakia*;[99] in Greek, *atraphaxis*; in Latin, *atriplex*; in Egyptian, *ohet*;[99] in India, *buthooa*.[100]

OXALIS. *Oxalis* sp.

There are two species which have been introduced into European gardens, but as an aliment they are there of little importance; they are yet included by Vilmorin[101] among kitchen esculents. The roots are the parts principally used, yet the acid leaves find use as a salad.

Oxalis crenata Jacq.

This species is cultivated in Peru in gardens about Lima,[102] and quite extensively in the mountains,[103] from Chili even to Mexico.[104] It was introduced into England in 1829,[105] and was for a time cultivated as a culinary plant.[106] It seems now to have fallen into disuse. Burr[107] included it among American garden esculents in 1863. A red and a yellow variety are mentioned.[105]

The *oxalis* is called in France, *oxalis crenelee, oxalide, surelle tubereuse*; in Flanders, *zverklaver*;[101] in Peru, *oca*.[105]

Oxalis deppei Lodd.

This species is said to be a native of Brazil, whence it was introduced into the kitchen-gardens of Europe,[108] reaching England in 1827.[109] In 1860 Loudon[110] says about 1850 it began to replace in esteem the *O. crenata*. The young leaves are served like sorrel, put into soup, or used as greens; the flowers are excellent in salad, alone or mixed with corn salad; the roots are served boiled.[109] It was likewise recorded by Burr[107] for American gardens in 1863.

[98] Schubeler. Culturpflanz, 80.
[99] Pickering. Ch. Hist., 248.
[100] Speede. Ind. Handb. of Gard., 154.
[101] Vilmorin. Les Pl. Pot., 1883, 395.
[102] Don. Gard. and Bot. Dict., 1831, I., 756.
[103] Gibbon. Amazon, 153.
[104] Heuze. Les Pl. Alim., II., 542.
[105] Bon Jard., 1882, 513.
[106] Gard. Chron., Dec. 8, 1883, 726; Loudon, Hort., 1860.
[107] Burr. Field and Gard. Veg. of Am., 1863, 41.
[108] Decaisne and Naudain. Man., IV., 102.
[109] Gard. Chron., 1841, 68.
[110] Loudon. Hort., 1860.

PARA CRESS. *Spilanthes* sp.

Under the name of Para cress several species of *Spilanthes* are occasionally cultivated, the piquant leaves being mixed with other salads, and having the property of stimulating the salivary glands; they should hence be classed with medical salads.

Spilanthes oleracea L.

Recorded as cultivated in France[111] in 1860 and in 1824, and in the Mauritius[112] in 1837, and is used also as a salad in the Mascarenhas, the East Indies and South America.[113]

It is called in France *cresson de Para, spilanthe, spilanthe des potageres,*[114] *abecedaire;*[115] in Germany, *hussarenknopf;* in Flanders, *ABC kruid;* [114] in Japan, *hoko so.*[116]

Spilanthes fusca H. P.

This species also cultivated,[117] and seems to be the *cresson du Bresil* of Vilmorin.[114]

PARSLEY, *Apium petroselinum* L.

This biennial is found wild in southern Europe, from Spain to Macedonia, also in Algiers and in the Lebanon.[118] It seems to be the *apium* of the ancient Romans, the *selinon* of Theophrastus,[119] who, 322 B. C., describes two varieties, one with crowded, dense leaves, the other with more open and broader leafage. Columella[120] A. D. 42, speaks of the broad-leaved and curled sorts, and gives directions for the culture of each, and, A. D. 79, Pliny[121] mentions the cultivated form as having varieties with a thick leaf, a crisp leaf, etc., evidently copying from Theophrastus. He adds, however, from apparently his own observation, that the *apium* is in general esteem, for the sprays find use in large quantities in broths,

[111] Noisette. Man., 1860, II., 367; L'Hort. Fran., 1824.
[112] Bojer. Hort. Maurit., 1837, 184.
[113] Unger. Pat. Off. Rept., 1859, 356.
[114] Vilmorin. Les Pl. Pot., 198.
[115] Noisette, l. c., 367.
[116] Black. Treas. of Bot.
[117] Bon Jard., 1882, 567.
[118] Decandolle. Orig. Des. Pl. Cult., 72.
[119] Theophrastus. Lib. VII., c. 4.
[120] Columella, Lib. XI., c. 3.
[121] Pliny. Lib. XIX., c. 37, c. 46. Lib. XX., c. 44.

and give a peculiar palatability to condimental foods. In Achæa it is used, so he says, for the victor's crown in the Nemean games.

A little later Galen,[122] A. D. 164, praises the parsley as among the commonest of foods, sweet and grateful to the stomach, and that some eat it and *Smyrnium* mixed with the leaves of lettuce. Palladius,[123] about 210 A. D., mentions the method of procuring the curled form from the common, and says that old seed germinate more freely than do fresh seed (a peculiarity of parsley seed at present, and which is directly the opposite to that of celery seed). Apicius,[124] A. D. 230, a writer on cookery, makes use of the *apium viride*, and of the seed. In the 13th century Albertus Magnus[125] speaks of *apium* and *petroselinum* as being kitchen-garden plants; he speaks of each as being an herb the first year, a vegetable the second year of growth; he says the *apium* has broader and larger leaves than the *petroselinum*, the petroselinum has leaves like the cicuta; that the petroselinum is more of a medicine than a food.

At the present time we have for forms the common or plain-leaved, the celery-leaved or Neapolitan, the curled, the fern-leaved, and the Hamburg or turnip-rooted.

I. The plain-leaved form is not now much grown, having become superseded by the more ornamental curled forms. In 1552, Tragus[126] says there is no kitchen-garden in Germany without it, and it is used by the rich as well as the poor, and Matthiolus,[127] in 1558 and 1570, says it is one of the most common plants of the garden. In 1778 Mawe[128] says it is the sort most commonly grown in English gardens, but many prefer the curled kinds, and in 1834 Don[129] says it is seldom cultivated. It was in American gardens in 1806.

Petroselinum. Trag., 1552, 459.

[122] Galen. De Alim., Lib. II., Gregorius ed., 1547, 154.
[123] Palladius. Lib. V., c. 3.
[124] Apicius. De Opsonibus, etc., Amsterdam, 1709.
[125] Albertus Magnus. De Veg., Jessen ed., 1867, passim.
[126] Tragus. De Stirp., 1552, 459.
[127] Matthiolus. Comm., 1558, 362; 1570, 512.
[128] Mawe. Gard., 1778.
[129] Don. Gard. and Bot. Dict., III., 279.
[130] McMahon. Am. Gard. Cal., 1806.

Apium hortense. Matth., 1558, 362; 1570, 512; 1598, 562; Pin., 1561, 333; Lugd., 1537, 700; Lob. ic., 1591, 706; Ger., 1597, 861; Dod., 1616, 694.

Garden parsley. Lyte's Dod., 1586, 696.

Common parsley. Ray, 1686, 448; McMahon, 1806, 127.

Plane parsley. Mawe, 1778.

Common plain leaved. Don, 1834, III., 279.

Plain parsley. Burr, 1863, 433.

Persil commun. Vilm., 1883, 403.

II. The celery-leaved or Neapolitan is scarcely known outside of Naples. It differs from the common parsley in the large size of its leaves and leaf stalks, and it may be blanched as a celery.[131] It was introduced into France by Vilmorin in 1823.[132] Pliny mentions parsleys with thick stalks, and says the stalks of some are white. It may be the *Apium hortense maximum* of Bauhin[133] in 1596, as the description applies well. He says it is now grown in gardens, and was first called English Apium. He does not mention it in his Pinax, 1623, under the same name, but under that of *latifolium.* Linnæus[134] considers this to be the *Ligusticum austriacum* Jacq.

It is figured by Bauhin in his Prodromus.[135] I have never seen it.

Persil celeri ou de Naples. L'Hort. Fran., 1824.

Naples or Celery-leaved. Burr, 1863, 434.

Persil grand de Naples. Vilm., 1883, 404.

III. The curled parsleys. Of these we have many varieties, differing but in degree, such as the curled, extra curled, moss curled, and triple curled. Pena & Lobel,[136] in 1570, mention this form, and say it is very elegant and rare, brought from the mountains the past year and grown in gardens, the leaves curled on the borders, very graceful and tremulous, with minute incisions. In the synonymy many of the figures do not exhibit the curled aspect which the name and description indicates; we hence make two divisions, the curled and the very curled. The curled was in American gardens preceding 1806.

[131] Vilmorin. The Veg. Gard., 1885, 380.
[132] L'Hort. Fran., 1824; Bon. Jard., 1824–5, 254.
[133] Bauhin. Phytopin., 1596, 268.
[134] Linnæus. Sp., 2d ed., 1680.
[135] Bauhin. Prodromus, 1671, 80.
[136] Pena & Lobel. Adv., 1570, 315.

(*a.*) The curled.

Apium crispum sive multifidum. Ger., 1597, 861, cum ic.

Apium crispum. Matth. Op., 1598, 562, cum ic.

(*b.*) Very curled.

Apium crispatum. Adv., 1570, 315: Lugd., 1587, 700.

Apium. Cam. Epit., 1586, 526.

Petroselinum vulgo, crispum. J. Bauh., 1651, III., Pt. 2, 97.

Curled. Townsend, 1726, 33; Mawe, 1778; McMahon, 1806, 127; Thorb. Kal., 1821.

Apium crispum. Mill. Dict., 1731, ex Mill. Dict., 1807.

Apium petroselinum. Bryant, 1783, 24.

Curled or Double. Fessenden, 1828, 222; Bridgeman, 1832.

Persil frise. L'Hort. Fran., 1824; Vilm., 1883, 404.

Dwarf curled. Fessenden, 1828, 222; Burr, 1863, 432.

Curled leaved. Don, 1834, III., 279.

IV. The fern-leaved has leaves which are not curled, but are divided into a very great number of small thread-like segments, and is of a very dark green. I first note it in American seed catalogues of 1878. It seems, however, to be described by Bauhin in his edition of Matthiolus, 1598, as a kind with leaves of the coriander, but very many extending from one branch, laciniate, and the stem leaves unlike the coriander because long and narrow.

V. The Hamburg parsley is grown for its roots, which are used as parsnips are. It seems to have been used in Germany in 1542[137] or earlier, but its use was indicated as of Holland origin even then in the name used, Dutch parsley. It did not reach England until long after. In 1726 Townsend,[138] a seedsman, had heard that "the people in Holland boil the roots of it, and eat it as a good dish," and Miller[139] is said to have introduced it in 1727, and to have grown it himself for some years before it became appreciated. In 1778[140] it is said to be called Hamburg parsley, and to be in esteem. In 1783 Bryant mentions its frequent occurrence in the London markets. It was in American gardens in 1806.

[137] Fuchsius. De Stirp., 1542, 573.

[138] Townsend. Seedsman, 1726, 33.

[139] Miller's Dict., 1807.

[140] Mawe. Gard., 1778.

Oreoselinum. Germanis Deutsch petersilg. Fuch. 1542, 573.
Petroselinum. Tragus, 1552, 459.
Apium. Cam. Epit., 1586, 526.
Apium hortense Fuchsii. J. Bauhin, 1651, III., Pt. 2, 97.
Apium latifolium. Mill. Dict., 1737.
Dutch parsley. Gard. Kal., 1765, 127.
Hamburg parsley. Mawe, 1778.
Broad-leaved. Mawe, 1778.
Hamburg or large rooted. McMahon, 1806; Burr, 1863, 433.
Large rooted. Thorb. Kal., 1821.
Persil tubereux. L'Hort. Fran., 1824.
Persil a grosse racine. Vilm., 1883, 405.

VI. A Persil panache is mentioned by Pirolle, in L'Hort. Français, 1824, but I find no further account.

The *Parsley* is called in France *persil;* in Germany *petersilie;* in Flanders and Holland *peterselie;* in Holland *pieterselie;* in Denmark *petersilje;* in Italy *prezzemolo, petroncino, erbetta;* in Spain *perejil;* in Portugal *selsa;*[141] in Norway *persille;*[142] in Russia *petruschka.*[143]

In Arabic *maquedounis, bagedounis,*[144] *kussah;*[145] in China, *hu-sui;* in Egypt, *bagdunis;*[146] in India, *vjmood, vjooaen khorasanee;*[147] in Japan, *kin, seri;*[148] in Persia, *karefo.*

PARSNIP. *Pastinaca sativa* L.

It has been supposed that the *pastinaca* of the Romans included the carrot and the parsnip, and that the *elaphoboscon* of Pliny[149] was the parsnip. Pliny describes the medicinal virtues of the *elaphoboscon,* and says it is much esteemed as a food. The references however do not prove this plant to be cultivated, nor do the references to the *pastinaca* satisfactorily indicate the parsnip. I am unwilling to accept such evidence as we find that the cultivated parsnip was known to the ancient Greeks and Romans.

[141] Vilmorin. Les Pl. Pot., 403.
[142] Schubeler. Culturpflanz, 94.
[143] McIntosh. Book of the Gard., II., 232.
[144] Delile. Fl. Æg. Ill.
[145] Birdwood. Veg. Prod. of Bomb., 163.
[146] Bretschneider. On the Study, etc., 15.
[147] Speede. Ind. Handb. of Gard., 181.
[148] Kaempfer. Amoen., 825; Thunberg, Jap., 120.
[149] Pliny, Lib. XXII., c. 37.

Among the early botanists there exists quite a confusion in names between the carrot and the parsnip. The root must, however, have come into general use long before these records, and perhaps its culture started in Germany, as it seems to have been unknown to Ruellius[150] in 1536, but is recorded by Fuchsius[151] in Germany in 1542, who gives a figure but calls it *gross zam mosen.* It is figured by Roszlin[152] in 1550 under the name *pestnachen*, and in 1552 is recorded by Tragus[153] as having a sweet root, used especially by the poor, and better known in the kitchens than fat.

The following is a synonymy founded on pictures and descriptions combined, all representing our long parsnip form of root, but some indicating the hollow crown, upon which some of the modern varieties are founded, especially Camerarius in 1586.

Sisarum sativum magnum. Fuchs., 1542, 751.

Pestnachen. Roszlin, 1550, 106.

Pastinaca. Trag., 1552, 440.

Pastinaca sativa. Matth., 1558, 353; 1570, 500; 1598, 548; Pin., 1561, 318.

Pastinaca domestica vulgi. Lob. Obs., 1576, 407; ic. 1591, I, 709.

De Pastinaca. Pastenay, gerlin oder moren. Pictorius, 1581, 94.

Pastinaca domestica. Cam. Epit., 1536, 507; Cast. Dur., 1617, 837.

Pastinaca sativa vulgi, Matthioli. Lugd., 1587, 719.

Pastinaca latifolia sativa. Ger., 1597, 870; Dod., 1616, 680.

Pastinaca sativa latifolia, Germanica, luteo flore. J. Bauh., 1651, II., Pt. 2, 150, 151.

Long parsnip of the moderns.

In 1683 the long parsnips are figured in England as in great use for a delicate sweet food,[154] are spoken of by Ray[155] in 1686, Townsend[156] 1726, Mawe,[157] 1778, and Miller[158] 1807, etc.

The round parsnip, or *Panais rond* of the French, is called *Siam* by Don[159] in 1834. Its roots are funnel-shaped, tapering very abruptly, often curving inwards. I find little of its early his-

[150] Ruellius. De Nat. Stirp., 1536.
[151] Fuchsius. De Stirp., 1542.
[152] Roszlin. Krauterb., 1550, 106.
[153] Tragus. De Stirp., 1552, 441.
[154] Worlidge. Syst. Hort., by J. W. Gent., 1683, 175.
[155] Ray. Hist., 1686, 410.
[156] Townsend. Seedsman, 1726, 22.
[157] Mawe. Gard., 1778.
[158] Miller's Dict., 1807.
[159] Don. Gard. and Bot. Dict., 1834, III., 339.

tory. It was noted in the *Bon Jardinier* for 1824, as also by Pirolle in Le Hort. Français, by McIntosh, Burr, and other more recent writers.

The introduction of the Parsnip to America was probably by the earliest colonists. It is mentioned at Margarita Island by Hawkins[160] in 1564; in Peru by Acosta[161] in 1604, as cultivated in Virginia in 1609[162] and 1648,[163] in Massachusetts in 1629,[164] and as common in 1630,[165] and were among the Indian foods destroyed by Gen. Sullivan[166] in Western New York in 1779.

The *parsnip* is called in France *panais, grand chervia cultive, pastenade blanche, patenais, racine blanche;* in Germany, *pastinake;* in Flanders and Holland, *pastenaak;* in Holland, *pinkster nakel;* in Denmark, *pastinak;* in Italy, *pastinaca;* in Spain, *chirivia;* in Portugal, *pastinaga*,[167] in Norway, *pastinak*.[168]

(*To be continued.*)

[160] Hawkins' Voy. Hak. Soc. ed., 27.
[161] Acosta. History of the Ind., 1604, 261.
[162] A True Decl. of Va., 1610, 113.
[163] A Perf. Des. of Va., 1640, 4.
[164] Higginson. Mass. Hist. Soc. Coll., 1st ser., I., 118.
[165] New England's Annoyances. 1630. Anon. The first recorded poem in America.
[166] Conover's Early Hist. of Geneva, 47.
[167] Vilmorin. Les Pl. Pot., 398.
[168] Schubeler. Culturpfl., 95.

EDITORIAL.

EDITORS, E. D. COPE AND J. S. KINGSLEY.

SOME interesting expressions of opinion as to the essential nature of organic evolution have been recently published in England. We refer to the addresses before the physiological and biological sections of the British Association for the Advancement of Sciences, by Dr. Burdon Sanderson and Sir William Turner; to the book "Darwinism," by Alfred Russel Wallace; and to the review of the latter by Prof. E. Ray Lankester, which has just appeared in *Nature*.

Dr. Burdon Sanderson distinguishes the functions of living beings into two divisions, growth and metabolism, which are the subject matter of two sciences, morphology and physiology. Evolution results from modification of growth, and as growth is really metabolism under some directive influence, it is interesting to note the aspect the subject presents to this able physiologist as expressed in the closing remarks of his address: "The word life is used in physiology in what, if you like, may be called a technical sense, and denotes only that state of change with permanence which I have endeavored to set forth to you. In this restricted sense of the word, therefore, the question, What is life? is one to which the answer is approachable, but I need not say that in a higher sense—higher because it appeals to higher faculties in our nature—the word suggests something outside of mechanism, which may perchance be its cause rather than its effect."

Sir William Turner says: "To reject the influence which use and disuse of parts may exercise both on the individual and on his offspring, is like looking at an object with only a single eye. All biologists will, I suppose, accept the proposition that the individual soma is influenced or modified by its environment. Now, if on the basis of this proposition the theory be grafted that modifications or variations thus produced are capable of so affecting the germplasm of the individual in whom the variation arises as to be transmitted to its offspring—and I have already given cases in point—then such variations might be perpetuated. If the modi-

fication is of service, then presumably it will add to the viability of the individual, and through the interaction of the soma and the germplasm, in connection with their respective nutritive changes, will so affect the latter as to lead to its being transmitted to the offspring. From this point of view the environment would, as it were, determine and regulate the nature of those variations which are to become hereditary, and the possibility of variations arising which are likely to prove useful becomes greater than on the theory that the soma exercises no influence on the germplasm. Hence I am unable to accept the proposition that somatogenic characters are not transmitted, and I cannot but think that they form an important factor in the production of hereditary characters."

These are the views of two of England's most distinguished biologists, and we find them to be in strong contrast to those expressed by Dr. Wallace and Prof. Lankester, no less able men in their respective fields. Dr. Wallace does not yet see beyond natural selection, and well illustrates the peculiar blindness to the nature of the origin of variations which is prevalent in quarters which hold to what they consider to be pure Darwinism, but which has been better termed "post-Darwinism." But as an illustration of how difficult it is to keep one's eyes from twisting to the right, Dr. Wallace does actually endeavor to explain the origin of the rotated eye of the flat-fish by appealing to the inheritance of an acquired character, which is ever increased by the transmission of additional acquisition. This is, as wittily remarked by Lankester, "flat Lamarckism." And Lankester has slipped into rationality in the same way, in attributing the asymmetry of the Gastropod Mollusca "to the cumulative effect of a mechanical cause." Both these gentlemen thus inadvertently abandon the major premise of the post-Darwinians—that acquired characters cannot be inherited. Prof. Weismann and others endeavor to sustain this position by experimenting on the inheritance of mutilation, as though it were not already sufficiently well known that broken heads and legs are not inherited! The evidence of palæontology ought to be of some value as to what is and what is not inherited, but this has not yet come fairly into the hands of

either Dr. Wallace or Dr. Lankester. "The American evolutionists" will soon furnish them with some additional information on this topic, all quite as much within the "scientific method" as are the speculations of Weismann, though Dr. Wallace and Prof. Lankester think that they have not done so in the past. According to the latter, the opponents of post-Darwinism are not "laboratory men," which explains their shortcomings. But there are laboratories and laboratories! The laboratories where section cutting and staining form the methods of studying nature are of high importance, but they do not cover the whole ground. Indeed, the adepts at this work are sometimes grossly ignorant of gross anatomy. In the estimation of some of these gentlemen the value of a scientific pursuit is inversely as the size of the objects studied. What the value of cetology can be in such eyes we do not know, unless it be something to be promptly sat upon.

—THE recent establishment of four geological surveys in as many States of the South, is a matter of congratulation. The first to lead the way was Arkansas, whose survey is in active prosecution by Prof. Branner. The Texas Legislature next inaugurated the work, and appointed Prof. Dumbel to superintend it. Prof. Dumbel has displayed much energy in getting his organization to work, and much is to be expected from his corps of able assistants. In the present number of the NATURALIST we announce the opening of the surveys of Missouri by Prof. Winslow, and of Georgia under Prof. J. W. Spencer. The people of the South were never more alive to the importance of developing the resources of their States, and of contributing their share to the stock of our knowledge of creation in all its aspects.

RECENT LITERATURE.

DeToni's Sylloge Algarum.[1]—This large volume of nearly fifteen hundred pages is devoted to the Chlorophyceæ, and bears he sub-title "Sylloge Chlorophycearum." In general appearance it is like the well-known Sylloge Fungorum of Saccardo, even to peculiarities of type and printing.

After a brief prefatory chapter, one hundred and thirty-nine pages are given to a most useful Bibliotheca Phycologica, in which about thirty-five hundred titles of papers and books on algæ are given, and also thirty-six titles of exsiccatæ. This portion of the work is particularly valuable to the student, as it enables him readily to find the extent of the literature in a particular department of the subject.

The Chlorophyceæ, according to DeToni, constitute a class including four orders, viz.: Confervoideæ, Siphoneæ, Protococcoideæ, and Conjugatæ, and these again are subdivided into families, apparently co-ordinate with the "orders" Phanerogams. The system is as follows:

CHLOROPHYCEÆ (Kuetz. ex parte) Wittr.

Ord. I.—**Confervoideæ** (Ag.) Falk.

A. OOGAMÆ.

Fam. 1. *Coleochætaceæ* (Naeg.) Prings.
" 2. *Mycoideaceæ* (Van Tiegh.) Hausg.
" 3. *Œdogoniaceæ* (De Bary) Wittr.
" 4. *Cylindrocapsaceæ* Wille.
" 5. *Sphæropleaceæ* (Kuetz.) Cohn.

B. ISOGAMÆ.

Fam. 6. *Ulvaceæ* (Lamour.) Rabeuh.
" 7. *Ulotrichiaceæ* (Kuetz.) Borzi.
" 8. *Chorolepidaceæ* (Rabeuh.) Borzi.
" 9. *Hausgirgiaceæ* DeToni.
" 10. *Cladophoraceæ* (Hassall) Witt. char. emend.
" 11. *Pithophoraceæ* Wittr.
" 12. *Gomontiaceæ*, Born & Flah.

Ord. II.—**Siphoneæ**, Grev. em.

A. OOGAMÆ.

Fam. 13. *Vaucheriaceæ* (Gray, Dumort.

[1] ***Sylloge Algarum omniam hucusque cognitarum***, digessit Doct. J. Bapt. DeToni. Instituti Botanici Patavini Adjutor, etc., etc. Vol. I. Patavii XXV., Julii, MDCCCLXXXIX. Sumptibus Auctoris, Typis Seminarii, pp. 12+CXXXIX+1315. 8vo.

B. ISOGAMÆ.

Fam. 14. *Dasycladiaceæ* (Endl.) Cramer.
" 15. *Derbesiaceæ* Thur.
" 16. *Bryopsidaceæ* (Bory.) Thur.
" 17. *Caulerpaceæ* Reicheub.
" 18. *Spongodiaceæ* Lamour.
" 19. *Udoteaceæ* (Endl.) J. Ag.
" 20. *Hydrogastraceæ* (Endl.) Rabeuh.
" 21. *Phyllosiphonaceæ* Frank.

Ord. III.—**Protococcoideæ,** (Menegh.) Kirch.
Fam. 22. *Volvocaceæ* (Cohn) Kirch.
" 23. *Palmellaceæ* (Decaine) Næg. em.

Ord. IV.—**Conjugatæ** (Link.) DeBary.
Fam. 24. *Zygnemaceæ* (Menegh.) Rabeuh.
" 25. *Desmidiaceæ* (Kuetz.) DeBary.

These families include two hundred and twenty-nine genera, and twenty-nine hundred and ninety-two (2992) species. Very many of the genera contain but a single species, there being no less than eighty-nine such, with many containing but two species. On the other hand, there are several large genera, *e. g.*, Œdogonium, with 189 species; Cladophora, with 229; Spirogyra, 84; Closterium, 103; Cosmarium, 307; Euastrum, 99; Staurastrum, 250.—CHARLES E. BESSEY.

Gremli's Flora of Switzerland.[2]—This little volume is a genuine pocket manual,—a trifle large, perhaps, but still small enough to be readily slipped into the traveler's coat pocket. It measures 4¾ by 7 inches, and is less than an inch in thickness. The contrast between these measurements and those of our ordinary manuals is striking, *e.g.*, Gray's, 8½ by 5¾ by 1½ inches; Coulter's, about the same; Chapman's, 8¾ by 5¾ by 1½; Wood's Classbook, 8½ by 6¼ by 1¾; Wood's Botanist and Florist, 8 by 5¼ by 1⅛. This contrast is still greater when we note the fact that this book contains descriptions of fully 2500 species, while Gray's has but 2348, and Coulter's 1881.

The descriptions are brief, but apparently quite satisfactory, and much space is saved by the liberal use of abbreviations. Keys are abundantly provided, so that there need be no difficulty in determining the name and classification of any plant.

In print, binding, and general appearance (including color), this

[2] *The Flora of Switzerland*, for the use of Tourists and Field-botanists, by A. Gremli. Translated from the fifth edition by Leonard W. Paitson, London. David Nutt, 270 Strand, 1889. Printed at Zurich. 12mo, pp. xxiv., 454.

little book resembles the well-known Baedeker's Handbooks.—CHARLES E. BESSEY.

Lubbock's Senses of Animals.[3]—One of the recent additions to the International Science Series is by the genial English naturalist, Sir J. Lubbock, and contains the results of his observations on the senses and intelligence of animals, especially of insects. Having found it necessary to consult many memoirs in various languages, in order to well understand the mechanism of the senses, and the organs by which sensations are transmitted, the author has in this work brought together the notes thus made, and given a list of the principal memoirs consulted. Commencing with man, Sir J. Lubbock works his way downward through the lower animals, dwelling chiefly upon the class which has especially engaged his attention. Chapter I. deals with touch; taste and smell have each a chapter devoted to them; hearing occupies two chapters, and sight takes up the chapters VI. and VII. The eighth chapter is on problematical sense-organs, such as the muciferous canal of fishes, light organs, etc. The range of vision and hearing, and the existence of unknown senses, are also here discussed. It is known that among ants, bees, and wasps, some at least hear sounds which we cannot, and that they can perceive the ultra-violet rays to us invisible. Chapter IX. refers to bees and colors, treating of the author's experiments, and answering Dr. Müller's objections. The limits of vision in animals form the subject of the tenth chapter, while the eleventh treats of recognition among ants, and the twelfth of the habits of solitary wasps and bees. Chapter XIII. deals with the supposed sense of direction, the possession of which he is inclined to deny to bees. In his chapter upon the sense of hearing, he does not argue that the vertebrate semicircular canals are the seat of such a sense. The last chapter details, among other things, the author's celebrated experiments with word-cards upon his dog Van.

RECENT BOOKS AND PAMPHLETS.

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BAUR, G.—Osteologische Notizen über Reptilien. Separatabdruck aus dem *Zoologischen Anzeiger*, 1888. From the author.

[3] On the Senses, Instincts, and Intelligence of Animals, by Sir J. Lubbock, M.P. F.R.S., etc. International Scientific Series LXV. Kegan Paul, Trench & Co., London, 1888.

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LYDEKKER, R.—Nototherium and Zygomaturus. Extract from the *Annals and Mag. Nat. Hist.*, Feb., 1889.—On the Remains and Affinities of five Genera of Mesozoic Reptiles. Extract from *Quarterly Journ. Geol. Soc.*, Feb., 1889. From the author.

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RILEY, C. V.—The Song Notes of the Periodical Cicada. Extract from the proceedings Am. Ass. Adv. Science, Vol. XXXIV. From the author.

ROMERO, DON MATIAS.—Speech on the 65th Anniversary of the birth of General U. S. Grant. From the author.

SHUFELDT, R. W.—Examples of Fractures and their Union in the Bones of Birds. In the *New York Med. Journ.* From the author.

The Western Society for Psychical Research. List of Members. From J. E. Woodhead, Secretary.

WILLARD, DEFORREST.—Osteotomy for Anterior Curves of the Leg. Reprint from the *Medical and Surgical Reporter*, Jan. 19, 1889. From the author.

WOLTERSTORFF, W. VON—Triton palmatus am Harz. Separatabdruck aus dem *Zoologischen Anzeiger*, No. 253, 1887. From the author.

General Notes.

GEOGRAPHY AND TRAVEL.

Africa.—Notes Concerning Stanley.—A letter from H. M. Stanley, narrating the difficulties encountered by him in the ascent of the Aruwimi or Huri, and accompanied by a sketch map, appears in the May issue of the Proc. Roy. Geog. Soc. As the contents of this letter, the sufferings from hunger, insects, poisoned arrows and horrors of every kind, and the final triumph, are now well known, they will not here be recounted. Hejambi Rapids (about 27° 19′ E.) marks a division between two kinds of architecture and language. Below, the houses are conical; above, the villages are long and straight, and the huts square and surrounded by tall logs which form separate courts. Huri is the most widely known native name for the Aruwimi. The Albert Nyanza seems to be growing smaller. Emin Pasha states that during his acquaintance with it islands have become headlands. Near the south end the steamer has to anchor about five miles from shore. The tribes of the forest and valley of the Huri are cannibals. Dwarf people, here called Wambutti, are numerous between the Hepoko and the grass-land, and are expert with their arrows.

Dr. R. W. Felkin has examined some of the arrows with which the Tikki-Tikki attacked Stanley and his party, and finds that the latter's idea that the poison is derived from ants is erroneous. The poison will kill in twenty minutes unless the antidote be used, and thus the deaths of Mr. Stanley's men were due to tetanus, which in tropical climates is often fatal to wounded men. The formic acid of ants, though an external irritant, is not a deadly poison. The poison used by the Tikki-Tikki is obtained from a tree which occurs both in Central Africa and on the east coast north of Mombasa. It is allied to the Strophanthus, but is more active and deadly.

Wadai and Darfur.—The third part of Dr. Nachtigal's work upon the Sahara and Sudan, dictated by the deceased traveler to a shorthand writer, has now been published by Mrs. Groddeck, to whom Dr. Nachtigal had confided its completion. One of the reasons which prevented Dr. Nachtigal from previously publishing it was his uncertainty regarding the Futa river, which he believed to be a continuation of the Welle, but purposed to settle the question in another expedition.

The map with this volume comprises the region between Lake Fibri and Khartoum. The territory of Wadai proper covers 64,000 square miles, but the authority of its ruler extends over several desert tribes, making a total area of 100,000 square miles, and a population of some two and a half millions. The northern part is hilly; the central well watered, with a light sandy soil; the southern covered with a rich clay. The Baltha and Butêha are dry during most of the year, though water can be found by digging, but in the rains they are mighty streams. Runga and Dar Kuti, subject to Wadai, are pagan; the first has fifteen, the second fourteen villages. Wadai is, on the whole, less fertile than Darfur, and still less so than Barum, but it is rich in ostriches in the north, and in elephants in the south. The population is mixed negro and Arab.

Darfur or Dâr-Fôr is about the size of Prussia, and has a population of more than 3,000,000 settled inhabitants, and half a million of nomads. The people are Arab and negro, more or less mingled. The Forâwa form the bulk of the population, and are dark-colored and middle-sized, *those in the remote parts still pagans.*

The Ubangi and Ngala.—A map in the June issue of the Proc. Roy. Geog. Soc. renders clear the accompanying papers of Captain Vangele, who has solved the question of the identity of the Welle and the Mobangi or Ubangi, and of Mr. J. R. Werner, who writes of the tributaries Ngala and Aruwimi, and of the back channel Ngiri, which connects the lower part of the Ubangi's course with the main Congo, there nearly parallel to it. In one place the two rivers approach very close, but north of 1° 30′ N. they diverge, the Congo's course lying nearly east and west, while the Mobangi continues west of north till it reaches 4° 30′ N., when the course bends eastward, its upper waters being the Welle and other streams of the Bandjia country. The Ngala or Mangalla has no connection with the Ubangi, but its upper course also trends eastward.

Madagascar.—L. H. Ransome describes and gives a map of the course of the river Antanambalana (Madagascar) in the May number of the Royal Geographical Society's Proceedings. This stream is in the northeast of the island, in the territory of the Betsimisaraka. The Antanambalana has no important tributaries, so far as surveyed, save the Vohimar, which enters it twenty miles from the mouth. The region is one of mountains covered with virgin forest. Among the timber are rosewood, ebony, and many hard woods as yet unknown to commerce. Mr. Ransome tells of a wild man, five feet nine inches

high, covered with thick black hair, who was caught by some Malagasy while asleep on a branch of a tree, and who died five months after his capture. He learned a few words, and conveyed the intelligence that he had a father and two brothers in the forest. The Betsimisaraka are darker than the ruling Hovas, and also hardier. The women are relatively tall, the men averaging five feet five inches. The dress of the men is a grass mat and piece of cloth round the loins, but some of the richer wear a white or bright tinted cotton garment called a lamba. The women wear a lamba, draped more closely, and fastened by girdle. Both sexes carry charms round the neck, and every native has a snuff-box of bamboo or horn. The only weapon is a spear, with a flat tail-piece for digging up roots. The houses are built on poles, the floor four to eight feet from the ground. There is usually but one room; the ascent is by a notched inclined pole, and there are no windows or chimneys.

German East Africa.—According to Dr. K. W. Schmitt (*Petermann's Mitteilungen*, May, 1889), the greater portion of German East Africa is not capable of remunerative cultivation, though there are highly fertile tracts, among them the wooded and mountainous region of Usambara and the western part of Bordie, and much of the country around Kilimanjaro. The country of the Nguru resembles Usambara in its geological formation, forests, and numerous small rivers. Useguha and other districts near form a vast waterless steppe, and vast steppes with oases of mountains stretch west of Usambara. Western Ukami is fertile, but beyond it extends the desolate Mkata steppe.

Mr. Arnot and Garenganze.—On January 7th of this year, Mr. F. S. Arnot read before the Royal Geographical Society an account of his wanderings in Africa, from 1881 to that date. With a very slender outfit, and without offensive arms, save for hunting, he first crossed Africa from Plutal to Bihé and Benguela, reversing Serpa Pinto's journey, and then traveled aross the Central Plateau of the continent to the sources of the Congo and Zambezi, discovering a mountainous and healthful country. The overflow of the Chobe river during the dry season is by Mr. Arnot explained by the nature of the soil around the northern feeders of this river. The porous ground absorbs the early rains, and the hills yield up their store towards the end of the latter rains. The Ovimbundu, an enterprising people living between Benguela and Bihé, told our traveller of a country called Garenganze, lying north of the Barotse region. This Mr. Arnot resolved to reach. The Ovimbundu bring to the Portuguese markets large quantities of

rubber from a root abounding in the plains east of the Kwanza and Kukema rivers. Between Bihé and Bailundu, (about 16° E.) springs of the Okovango, which flows to Lake Ngami are met with close to those of feeders of the Kwanza, which flows northwards. Westward of this the territory of the Vachibokwe was entered, and the sources of the Kutia, a tributary of the Kwanza, were passed. Soon afterwards the head of the Monyango, the southern-most feeder of the Kasai, was met with; and a little further on were the springs of the Elume, which runs into the Zambezi. The Vachibokwe are active and industrious, and were the first to discover a method of extracting rubber from the "Talamba" root. Eastward of these are the Luvale or Va-luena. Kangombe, a Va-luena chief, is a great slave hunter, and the terror of the Lunda or Muata-yamoo. Beyond the Lumese and Luena tributaries of the Zambezi is the great Kifumadji flat, which in the rainy season is flooded to a depth of two or three feet. The Lunda country was then crossed in sight of the Zambesi, here flowing westward. Kaomba Mountain or Border Craig, as Mr. Arnot styles it, marks the watershed between Zambesi and Congo. The country became mountainous about 25° E., and the Lokoleshe, Lufupa, Luburi, and Lulua were large streams crossed before the Lualaba was reached—all flowing northwards. The Sambau mountains, inhabited by a portion of the Samba tribe, who dwell in caves, were left to the left hand, and then, after passing the Lukurawe, a rugged mountainous land was entered. Leave of Msidi, the potentate of Garenganze, had to be asked before entering the capital. Auguries were consulted before admitting the visitor, and fortunately these proved auspicious. Garenganze is a name made by Msidi for the kingdom he has created. The Arabs knows it as Katanga. The capital is on an immense plain called Mukurra, with high mountains on two of its sides. Msidi's town consists of a number of villages around a double-topped hill in the south of the plain. Msidi's kingdom extends from the Lualaba to the Luapula, and from the Luba country on the north to the mountains dividing the Congo and Zambezi water-systems. Mr. Arnot stayed at Msidi's capital for more than two years.

The Leeba of Livingstone is really the Zambezi.

The great Lombwe caves are very remarkable and extensive, and are inhabited by a considerable number of natives. One cave, the the Kotasa, has two mouths, the distance between them being five miles.

Asia—Ascents in the Caucasus.—Koshtantan, 17,091 feet high, in the main Caucasus, has been ascended by A. F. Mummery, after the failure of a first attempt. Mr. H. W. Holder has ascended some of the peaks around the Bezingi Glacier, including Salananchera (about 15,500 feet), Koshtantan, and Kartantan, or the Saddle Peak (about 16,500 feet); and Mr. Cockin, who accompanied Mr. Holder and stayed behind, afterwards ascended Shkara (17,200–17,300 feet), and the second peak of Djanga (16,700–16,800 feet), and then, crossing to the south side of the chain, ascended the northern peak of Ushba. Koshtantan is somewhat higher than Dychtan, thus proving the correctness of the measurements of the Russian survey. In an attempted ascent of the Mishirgi Tan, Mr. Holder and his companions were brought to a stand at 13,000 feet. They estimate the height of that peak at a little more than 16,000 feet, and it lies but slightly southeast of Koshtantan. The main glacier streams of the Caucasus, the Bezingi, Mishiri, and Dych Su, have but slight fall, but the smaller upper streams which form them are cascades of ice.

Notes from Prjevalsky's Last Journey.—In his fourth voyage, Gen. Prjevalski explored a portion of the Keren-Lim that had not been previously visited, forming an arc of a circle with the convexity to the north. Towards the east, by the chain of Marco Polo, the already known portion of the range is reached. This convex range consists of several parallel chains, named Columbus, Moscow, Russia, Prjevalski, separated from each other by wild valleys with a poor flora and fauna, but rich in gold. One of these valleys, 210 kilometres long, with a width varying from 21 to 42 kilometres, was named by the traveller the "Valley of the Winds," on account of its formidable tempests. Gen. Prjevalski believes that this valley affords the best means of communication between China and East Turkestan, also the shortest (1,700 kilometres).—*Revue de Geographie.*

Bokhara.—According to Dr. Heyfelder (*Petermann's Mitteilungen*, Vol. VII, 1889), Bokhara has an area of 275,000 square kilometres. The Tadjiks, the primitive Iranian race, though a tall fine people, have been conquered by the more war-like and energetic Turanian Auzbecks, The Tadjiks are agriculturalists, gardeners, artisans, merchants; the Ausbecks by preference functionaries or soldiers. Arabs are numerous, also Persians, and the language of the latter is that of the court and of good society. The Jews are attired somewhat like those of Poland, and their commercial relations extend to Russia, France, Austria, and England. The Hindus are small and feeble; they are small tradesmen,

and given to usury; if they become rich, they recross the frontier. Afghans attend the markets from time to time, and some settle and purchase lands. There are 2,000 Europeans in the Khanate, counting the Russian garrisons of Chardjui and Korki.

America.—Dr. Nansen's Journey across Greenland.—Dr. F. Nansen read an account of his memorable journey across the inland ice of Greenland, before the Royal Geographical Society, on June 24, 1889. The result of the expedition was to prove that Greenland, at the point crossed (61°–64° N. lat.) is covered with a shield-shaped stratum of ice, of such thickness that it fills up all irregularities in the surface, rising rapidly but regularly from the east coast to a height of 9,000 to 10,000 feet, almost flat in the middle, and falling again regularly toward the west coast. Some geologists argue from this that the interior is a vast tableland, but Dr. Nansen believes that it is not, but that Nordenskjold was right in believing the internal configuration of the mountains comparable to that of Scandinavia. If there are deep fjords and lofty mountains on the coast, he argues that the ice has also excavated deep valleys in the interior. The surface of the snow-field consists of soft, loose and dry snow, readily moved by the wind, and is even and polished like a lake in still weather. Thin ice-crusts, the product of summer meltings, occur at intervals, but hard ice or snow cannot be found with the six-foot sticks used in *ski* or snow-shoe running. The party had a snowfall almost every day, and as there is no real snow-melting in the interior, the melting of the day freezing again at night, it would seem that the quantity of snow is still increasing. Yet the flowing of the ice to the shores keeps it down, the surplus coming to the coast as water as well as ice.

Geographical News.—America.—The population of British Guiana at the end of 1887 was 277,038, of whom 102,746 were East Indians.

It is probably not generally known that the Santa Cruz Indians about fifty years ago drove out the Mexicans from southwest Yucatan, and have since retained possession. Mr. W. Miller crossed this territory last year from Bacalar to Santa Cruz. The Indians pretend to be Christians, remember a few prayers, and have rude churches, but no priests. Near Tutum is an oracular cross, and the belief is firm that the voice which issues from it is that of God. In one village are several whites, descendants of Spaniards, but in dress, manners and ideas reduced to the Indian level.

J. Bellamy (Proc. Roy. Geog. Soc., Sept., 1889) describes an expedition to the Cockscomb Mountains of British Honduras. The highest peak, Victoria, is a little below 4,000 feet. The interior of this country is less known than Central Africa.

In 1857 only 4,951 immigrants reached the Argentine Republic; in 1888 the number was 155,632. At the present rate of increase, the population by the end of the century will be 7,000,000. Sixty-five per cent. of the immigrants are Italians, fifteen per cent. Spaniards, and ten per cent. French.

Europe.—In the immense empire of Russia, with a population of 108,787,235 in 1885, there were at that date, according to Dr. Göhlert (Ausland, 1888), only 36 towns with more than 50,000 inhabitants, and only 13 with more than 100,000. The latter are: St. Petersburg (861,303), Moscow (753,469), Warsaw (454,298), Odessa (240,000), Riga (176,332), Kharkhov (171,426), Kiev (165,561), Kazan (139,015), Saratov (122,829), Tashkend (121,410), Kichenev (120,074), Lodz (113,413), and Vilna (102,845).

According to the preliminary results of the census of Switzerland, taken Dec. 1st, 1888, the total population at that date was 2,934,055, as compared with 2,846,102 in 1880. The slightness of the increase is accounted for by the excessive emigration. During the eight years above, 160,000 Swiss left the country.

Geographical News.—Africa.—The Germans have been active in the survey of the Cameroons and Gold Coast. Kund and Tappenbeck, with 240 men, started last year on a second expedition to the upper courses of the Sannaga and Njong. It was found that the lower course of the latter river lies seven minutes west of its position on existing maps. Dr. L. Wolf has passed through the hitherto unknown Udjuti country.

The most recent estimate of the population of Morocco places it at 9,400,000, viz., 3,200,000 in Fez, 3,900,000 in Morocco proper, 850,000 in Tafia, and 1,450,000 in Sus, Adrar, and the northern Draa. This estimate exceeds all previous ones.

Dr. Colin has prepared a map of the district of Bambuk (Senegambia), and his survey has definitely fixed the topography of the country and proved errors in former maps. Thus the river Faleme, instead of running straight to Labe in Futa-Djallon, bifurcates into two streams of almost equal importance.

From a note in the September issue of the Proc. Roy. Geog. Soc. it appears that the Lake Basso-narok is identical with Lake Samburu, and that the river Omo of Borelli discharges into it. MM. Teleki and Hoenel declare that it has no outlet. As the Samburu is 1,970 feet above the sea, while the Victoria Nyanza is 3,800, this lake must form a distinct basin.

An article upon nilometers in the Proc. Roy. Geog. Soc. for January, by Col. Ardagh, contains many interesting facts respecting those methods of measuring the rise of the Nile. It seems that the estimates now given by the Sheikh in charge are utterly unreliable.

MM. Delcommune and Haneuse have performed a voyage of 503 miles on the Lomanie, and have arrived within three days' march of Nyangwe. They have proved that this stream is the one traversed by Wissmann and Pogge after leaving Nyangwe. The river is 250 metres wide, and 12 to 18 deep, and affords the most direct route from Stanley Falls to Lake Tanganyika.

According to Prof. Virchow, positive data have been obtained to prove the existence of an Egyptian stone age; but there is a yawning gap between this evidence and the time of Menes. Skulls of the older dynasties agree with statues of the temple-building kings to prove that in old times the type of the Egyptian skull was brachycephalic. But the modern fellaheen are long-headed. Prof. Virchow believes in the distinctness of both Egyptians and Nubians from the negro. The latter never changes color, while in the former color deepens by exposure to sun, and vice versa. This is why the Egyptians painted the men red, and the women light yellow.

Baron v. Steinacker does not give a very roseate picture of the German Protectorate in Southwest Africa in his recent article in the *Mitteilungen*. There seems to be no available harbor along the coast save Walfish Bay, which is English; the coast is without water, the middle districts have few spots favorable for agriculture, and it is only in the north and northeast that the agriculturist can have scope. The southern parts of the Kubango and Chobe districts are impassable swamps in the rainy season. The Hereros and the Hottentots are at constant strife. The report is accompanied by a map, embodying the Baron's surveys, as well as previous ones.

M. Camille Douls has been assassinated by his guides, between the Oases of Alouef and Akabli, 900 kilometres south of Oran; but whether from fanaticism or cupidity is not known. As on his previous journey, he was in the disguise of a Mussulman.

M. Foa and two other Frenchmen have ascended the Whene, or Ouené, which forms the boundary between Dahomey and Porto Novo.

M. Crampel made in 1888 an important journey of discovery o the country northwest of the Ogowé, reaching the Upper Ivindo, largest tributary, and penetrating to the boundary between the French and the German possessions. The natives of this part are known as the Pahuins. A stream called N'Tem, flowing westward, was discovered, and M. Crampel believes it identical with the upper course of the Campo.

Asia and Oceanica.—Sir Wm. Macgregor, Administrator of British New Guinea, has returned to Port Moresby, after the ascent of a crest of the Owen Stanley range named Mt. Victoria, 13,121 feet above sea-level. A newly discovered mountain north of this range he has named the Albert Edward, and estimates its highest peak at 12,500 ft. The country along the range of mountains ending in East Cape is fully inhabited, and full of cocoa-nut trees. The island of Tubutubu, in the Engineer group, is very populous, and the people are great traders. Between Milne Bay and Mullen's Harbor, on the main land, there is a range of hills some 800 feet high, basalt on the Milne Bay side, coral limestone on the other face. From Mullen's Harbor a canoe trip was undertaken for the purpose of visiting the fierce and hostile Werewere, and impressing on them the policy of keeping on good terms with the Government.

Dr. H. Zöller, accompanied by three officers, has ascended the Finisterra range in New Guinea to a height of 9,000 feet, and reports that Mount Gladstone still rose 1000 feet higher. A new range between the Finisterre and the Bismarck ranges was found, and named the Kràtke. Its apparent height was 10,000 feet. About 140 miles of country were surveyed.

The conclusion of Dr. A. Meyer, that no water-way exists between Macluer Inlet and Galvink Bay (New Guinea), has received confirmation from Dutch officials who have investigated the matter, and from Lieut. Ellis, who explored the coast from May to November, 1887.

M. Eugene Markow, M. Popoff and seven others have recently ascended Mount Ararat. The limit of eternal sun was crossed at 13,500 feet, but at 14,000 a lady-bug was found, and some flowers were gathered at 15,500. The travelers erected a cairn at the summit, which will visible at the base, and may thus serve to dissipate the superstition of the natives, who will not believe that any one has ascended the holy mountain.

Mr. S. E. Peal (Proc. Roy. Geog. Soc. Feb. '89.) has an interesting article upon the origin and orthography of river names in Indo China. It seems that the great eastern tributary of the Upper Irawadi is spelled in no less than thirteen different ways, and that the Salwin has thirteen other designations beside that here given.

M. Alexandron has determined the height of the Khan Tengri, in the Thian Shan, at 23,950 feet.

Baron Sternberg and a party recently attempted the ascent of Elbruz, but only succeeded in reaching the saddle or depression between the two main peaks. Though they spent sixteen hours at a height of 17,840 feet, they felt no symptoms of mountain sickness.

The well-known Prof. Schweinfurth was, from Nov. 1838 to March 1889, in Arabia Felix, with the object of making botanico-geographical studies. Travel is safe in Yomen, and the natives are courteous towards Europeans. The designations "stair-mountain" and "step-mountain," both found in old hieroglyphics, refer especially to the cultivated terraced slopes of South Arabia, and possess no meaning if applied to the Somali country. The ancient Egyptians dedicated certain trees to particular deities. Thus the sycamore was sacred to Athor, and the fruit of the persea (*Mimusops schunperi*), was a gift to the gods and to the departed. The persea has for several centuries disappeared from Egypt, but the sycamore still exists there. The persea grows wild in Nomen.

M. E. Favec contributes to the August issue of the Proc. Roy. Zool. Soc. an account of his explorations on the Upper Gascoyne and Ashburton rivers, in West Australia. The result of the trip was the discovery of several large tributary rivers running into the Ashburton, and on the Gascoyne there are indications of the existence of gold reefs.

Siberia has a railway from Samara to Oufa, opening up the riches of the Ural.

The three first sheets of the map of Central Asia, published by the Russian Government, and containing Lake Baikal, the basin of the Amur, and the coast of the Japan sea, have appeared. When complete this map will have thirty-two sheets, and will represent the entire country between the Caspian and the east coast of Asia, on a scale of 1–1,630,000.

GEOLOGY AND PALÆONTOLOGY.

Archean Characters of the Rocks of the Nucleal Ranges of the Antilles.[1]—During a visit this year to the southeastern part of the island of Cuba, the speaker had made some examinations of the rocks which form the nucleus of the spurs of the Sierra Maestra, and there is strong reason to believe of the axial range of the entire island and of Jamaica, Santo Domingo, Puerto Rico, and the Windward Islands as well. From the field observations there made, and an examination of the specimens under the microscope, it seems highly probable that these rocks, instead of being igneous extrusions of the Tertiary period and later, are in reality of much earlier date, and may not be entirely volcanic.

The considerations which support this view are—

1. Microscopic analysis shows immense alteration to have taken place, and consequently a very long period to have elapsed.

2. The complexity of the congeries of rocks forbids the hypothesis of their having been derived from one mass. Where this congeries, therefore, is unconformably adjacent to the Tertiary, there can be no reasonable doubt that the crystalline rocks are the elder. This point of view was suggested by Mr. Teall, who would consider the argument valid also for the contact with the Cretaceous, and perhaps older series. It is difficult to see why it should not hold equally good for the contact between these crystalline and the Paleozoic rocks as made out by De Castro near Cienfuegos, etc.

3. The characters of the several associated rocks are those which one finds united in very many Archean regions throughout the world.

4. The products of alteration of these rocks are similar to those which one finds in the districts just alluded to.

5. The chemical peculiarities of the iron ores found in contact with these rocks are similar to those which one finds in the ores of the Archean regions, both in the low percentage of phosphorous and in the pyrite and (more sparingly) chalco-pyrite disseminated through the ore, and in other respects.

6. If this nucleal mass had been forced up from the earth's interior in a state of igneous fusion there would not be now (as there are) abundant traces of stratification and structure, implying an original sedimentation.

[1] Read by Dr. Persifor Frazer at the Bath Meeting of the British Association, 1888.

7. If this mass had resulted from volcanic outflow there must have been contact phenomena, and changes induced on the surfaces of the rocks with which it was brought in contact. No such contact alteration has been observed between these rocks and those of either the Paleozoic, Mesozoic, or Cænozoic groups which in different localities meet them.

8. The direction of the range, considered as a whole, lends support to the hypothesis that it is a fork of the Andes which, diverging from the main axis in Guatemala, traverses the peninsula of Yucatan, and in a symmetrical curve sweeps through the highlands of Cuba and Jamaica, Hayti, Puerto Rico, the Windward Islands and the northeast coast of Venezuela. This rim of high land once enclosed the Caribbean as another Mediterranean Sea.

9. The shapes of the hills of this range, produced by weathering, are not those usually visible in regions of volcanic, but rather of metamorphic rocks.

The rocks which furnished the basis for the above conclusions are all, or nearly all, alteration products. In some cases they appeared to be the results of a series of metamorphoses, some of their constituents seeming to pass through cycles of change, ending in the mineral with which the alteration began after a number of intermediate stages. The rocks are diabases or diorites, with epidote, porphyritic dolerites, which resemble and have been taken for syenites; garnet rock; actinolite; felsite and orthofelsite porphyry, like that of the South Mountain of southeastern Pennsylvania, of St. David's Head in Wales, and elsewhere. To these are added pyrite, and iron ores and crystalline limestone. Copper and manganese ores are not rare, but their relations to the rocks under consideration have not been made out.

NOTE.—A number of the first petrologists of Europe who have examined the slides are disposed to consider the specimens of not later than Paleozoic age, while none are willing to deny that they *may* be earlier.

MINERALOGY AND PETROGRAPHY.[1]

Petrographical News.—A most interesting rock is described by Osann[2] as forming the body of the hill known as Hoyazo, in the Spanish Province Almeria. The rock is an andesite consisting of a ground-mass of colorless glass containing small crystals of cordierite, flakes of biotite, lath-shaped microlites of plagioclase, and of an orthorhombic pyroxene, in which are porphyritic crystals of labradorite, a large quantity of biotite, columnar crystals of bronzite, hornblende, augite, and cordierite. The last-named mineral occurs in the form of irregular grains associated with quartz, and also in well-developed crystals, with a pleochroism: A = yellowish-white; B = dark violet; C = light violet. In the rock are inclusions of quartz, of aggregates of quartz and cordierite, and of a biotite gneiss rich in cordierite and garnet. A portion of the cordierite, separated from the rock, was analyzed with this result:

SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	Sp. Gr.
48.58	32.44	3.15	9.17	tr	6.03	2.625–2.628

The mineral is usually fresh, but contains numerous inclusions of sillimanite, whose composition is: $Al_2O_3 = 63.52\ \%$, $SiO_2 = 35.43\ \%$. The granular cordierite is supposed to represent the remains of foreign inclusions in which the mineral was an original constituent. The crystallized variety is thought to have arisen from the solution of a portion of the inclusions and a subsequent re-separation of cordierite, as well-developed crystals. The author regards the same explanation as applicable to all the cases in which cordierite has been found in volcanic rocks, *i.e.*, it is a secondary mineral produced by the solution of foreign inclusions in the magma of the eruptive.——Lacroix[3] intends to make a complete study of pyroxene gneiss, and of rocks containing scapolite. He has published the first results of his work in a very excellent paper which is occupied with descriptions of the rocks of these two classes, together with the rocks associated with them as they are found in Brittany and in other parts of France, in Saxony, Austria, Spain, Algeria, Norway, Sweden, New York, Canada, Ceylon, India, and a few other places. As is to be expected, Lacroix finds many interesting facts connected with the structure, composition and genesis

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.

[2] *Zeits. d. deutsch. geol. Gesells.*, XL., 1888, p. 694.

[3] *Bull. Soc. Franc. d. Min.*, XII., 1889, p. 83.

of these two little-known rock groups. He has discovered that the scapolite rocks are sometimes the result of contact phenomena in marbles. Sometimes they are the result of the alteration of gabbros, and sometimes they are original. In every case it is found that there is a tendency of the rock to possess as constituents one or more rare rock-forming minerals. As the writer has examined all these very carefully, his paper is a mine of wealth to the petrographer who has to deal with rare minerals. Among the most interesting observations described may be mentioned the existence of dumortierite and cordierite in a gneiss from Bamle, Norway; fuchsite in a mica-schist from Salem, India; and the new mineral fouquéite in a gneiss from the same vicinity. Original epidote and parallel growths of this mineral with allanite in a pyroxene gneiss from Morbihan, France, and in a scapolite gneiss from Odegården, Norway, are described, as are also the regular arrangement of rutile needles in phlogopite and garnet and micropegmatitic intergrowths of pyroxene and quartz (page 297), pyroxene and oligoclase (pp. 316–318), garnet and quartz (p. 317), and amphibole and oligoclase (p. 319). The varieties of feldspar known as sun-stone and esmarkite are referred to, the properties of the minerals of the scapolite group are discussed, and the occurrence of secondary and original wollastonite and wernerite is mentioned. Contact rims consisting of hypersthene and amphibole, and tremolite and amphibole, are pictured around olivine in olivine-gabbros, and a rim consisting of biotite and amphibole is figured as seen around ilmenite. In addition to the observations made by Lacroix, there are incorporated in the paper descriptions of the facts discovered by earlier workers in the domain of these rocks. It therefore becomes a valuable compendium of our knowledge of scapolite rocks, so far as known. In connection with his description of the New York rock, Lacroix gives an interesting account of the properties of the minerals found in the neighborhood of Pierrepont.——Mr. J. P. Iddings[4] has just published one of the most interesting papers that has yet appeared on the subject of lithophysæ. The article opens with a description of the macroscopic structure of the great mass of obsidian known as Obsidian Cliff, in the Yellowstone National Park. The most striking feature of the southern portion of the mass is its perfect columnar structure, with the columns all perpendicular to the surface over which the rock flowed. A petrographical description of the rock follows, and it is in this portion of his paper that the author shows well his ability to treat a complicated subject. Spherulites and lithophysæ are minutely

[4] Seventh Ann. Rep. Direct: U. S. Geol. Survey, p. 255

described, and very fine pictures of the structures are given. Without being able to enter into a full discussion of the points so clearly brought out by Mr. Iddings, it is interesting to note that he regards the lithophysæ as having been produced, after the partial solidification of the rock in which they occur, by the expansion of the vapors imprisoned within the rock-mass before its eruption. The formation of the minerals coating the walls of the cavities was caused by the action of this water upon the materials of the rock. The expansion of the vapors was due to the diminution of the pressure under which they were confined in consequence of the upward bending of the rock layers above the places now occupied by the lithophysæ. These conclusions are in direct opposition to those of Szabo, Roth, Zirkel, and Cole,[5] who regard lithophysæ as resulting from the alteration of spherulites.——A nephelinite composed of a granular aggregate of nepheline cementing porphyritic crystals of olivine, shreds of biotite, microlites of augite and magnetite, is announced by Levy and Callot[6] as existing in a boss near Rougiers in Var, France.

New Minerals.—*Tephrowillemite.*—Dr. Koenig[7] communicates the discovery of a brownish-gray, resinous, infusible substance at the Trotter Mine, Franklin, N. J. Only a portion of a single mineral was obtained, which yielded on analysis:

$SiO_2 = 27.75$, $ZnO = 60.61$, $MnO = 10.04$, $Fe_2O_3 = 1.80$, $CaO =$ tr.

It is a *manganese willemite* with the formula $(ZnMnFe)_2\ SiO_4$.——*De-Saulesite.*—Associated with the above-described mineral, and also with *sphalerite*, *chloanthite*, *fluorite*, *apatite* and *nicolite*, beneath a stratum of yellow garnet, at a depth of 340 feet from the surface, is a greenish substance encrusting fluorite and filling cavities in it. In the closed tube it yields water and turns brown. It is infusible before the blowpipe, but at this high temperature it regains its original color. Its composition is:

SiO_2	NiO	ZnO	FeO	CaO	MgO	As_2O_5	H_2O at 100°	H_2O at 600°
31.62	38.22	4.00	2.03	.70	.42	4.77	9.44	7.14

corresponding to $NiZnFe\ (SiO_3) + 1\frac{1}{2}$ Aq. It is therefore a *nickeliferous garnierite.*——*Yttrialite.*—From the gadolinite locality in Llano County, Texas, five miles south of Bluffton, Messrs. Hidden and Mackintosh[8] have discovered a very large number of new and rare

[5] AMER. NATURALIST, Jan., 1887, p. 70.

[6] *Comptes Rendus*, 1889, p. 1124.

[7] *Proc. Acad. Nat. Sciences, Phila.*, Pt. II, 1889, p. 184.

[8] *Amer. Jour. Sci.*, Dec. 1889, p. 474.

yttria and thoria minerals associated with less rare compounds in the quartz veins cutting granite. Among the bodies new to mineralogy was found a yellowish substance in large masses with an olive-green color on a fresh fracture. Its specific gravity is 4.575, and its hardness 5–5.5. It is soluble in hydrochloric acid, decrepitates when heated, and breaks into an infusible and insoluble powder. Its composition is:

SiO_2	PbO	ThO_2	MnO	FeO	CaO	Al_2O_3	Ce_2O_3	Y_2O_3	$(LaDi)_2O_3$
29.17	.854	12.00	.77	2.89	.60	.55	1.86	46.50	2.94

UO_2	Ign.
.83	.79.

——*Thorogummite* usually occurs in small pieces intimately associated with *fergusonite* and *cyrtolite*. It has a dull yellowish-brown color, a hardness of 4–4.5, and Sp. Gr. of 4.485. Occasionally groups of crystals with a ziron-like habit have been found. The mineral becomes of a dull greenish hue after ignition, and is soluble in nitric acid. Composition:

SiO_2	UO_3	ThO_2	Al_2O_3	Fe_2O_3	$(CeY)_2O_3$	PbO	CaO	H_2O	P_2O_5	Ign
13.085	22.43	41.44	.965	.845	6.69	2.16	.41	7.88	1.19	1.23

corresponding to $UO_6(ThOSi)_3$, $(OH)_{12}$, or *gummite* in which the water has been replaced by thorite.——*Metagadolinite* is a grayish brown amorphus alteration product of gadolinite from the above mentioned locality. It has a red streak, a hardness of 3, and a specific weight of 3.494. Mr. Goldsmith [9] has made an approximate analysis of it, and regards it as a new mineral.[10] His result is:

SiO_2	YO(?)	Ce_3O_4(?)	Fe_2O_3	CaO	MgO	H_2O
18.145	21.854	20.662	26.026	3.642	2.14	9.761

——*Daviesite.*—Associated with other decomposition products of lead ores at Minas Beatriz, Sierra Gordo, Chili, Mr. Fletcher [11] discovered tiny, colorless, prismatic crystals of an orthorhombic mineral, with an axial ratio 1.2594 : 1 : .6018, and the plane of its optical axes parallel to $\infty P\overline{\infty}$. From the few chemical tests made upon the small amount of material at his command, Fletcher supposes the mineral to be an oxychloride of lead.——*Dudgeonite* [12] was found at the Pibble Mine, near Creetown, Scotland, in little cavities occurring in *nickeline*. It a grayish-white earthy substance, with a slightly resinous lustre. Its

[9] *Proc. Acad. Nat. Sci. Phila.* Pt. II., 1889, p. 164.

[10] Cf. F. A. Genth. *Amer. Jour. Sci.*, Sept. 1889., pp. 198–200.

[11] *Miner. Mag.*, VIII., May, 1889, p. 171.

[12] Heddle: *Miner. Mag.*, May, 1889, p. 200.

hardness is 3–3.5. In composition it corresponds to *annabergite*, with one-third of the nickel replaced by calcium ($\frac{2}{3}$NiO, $\frac{1}{3}$ CaO)$_3$ As_2O_5+ 8 H_2O. [NiO=25.01, CoO=.76, CaO=9.32, As_2O_5=39.33, H_2O= 25.01].——*Hydroplumbite* and *Plumbonacrite.*— The former mineral is in very small scaly crystals, with a pearly lustre, forming thin flakes of a pure white color, covering all the lead minerals of a specimen of associated lead ores, that probably came from Leadhills, Scotland. The amount of the new mineral obtained was too small for analysis; but from the synthesis of a similar substance, Heddle [13] infers that its composition is 3PbO H_2O. The second mineral (from Wanlockhead) resembles *hydroplumbite* in appearance, but yields upon analysis a result corresponding to the formula $PbCO_3$+3 PbO H_2O [PbO=92.85, CO_2=4.76, H_2O=2.01, residue=.78].——*Flinkite* is described by Hamberg[14] from Pajsberg, Sweden. It occurs in greenish-brown tabular orthorhombic crystals, with a hardness of 4.5, and Sp. Gr =3.87. Its composition is:

As_2O_5	Sb_2O_5	Mn_2O_3	Fe_2O_3	MnO	CaO	MgO	H_2O
29.1	2.5	20.2	1.5	35.8	.4	1.7	9.9

——*Fouquéite.*—In his excellent paper on scapolite rocks, Lacroix [15] describes a dimorphous form of zoisite occurring as a constituent in an anorthite gneiss from the District of Salem, Madras, India. The new mineral is found in corroded and rounded monoclinic crystals, elongated in the direction of their *c* axes, and polysynthetically twined with the orthopinacoid as the composition face of the various lamellæ. They possess a well-marked cleavage parallel to the face assumed as the basal plane, which makes an angle of 108° with $\infty \bar{P}\infty$. The plane of their optical axes is oP, and the optical angle $2V$ is about 90°, with *b* as the positive acute bisectrix. The pleochroism is weak in yellow tints. The mineral is infusible before the blowpipe, and has a specific gravity of 3.24–3.31. It occurs in two varieties, the compositions of which are as follows:

	SiO_2	Al_2O_3	FeO	CaO	Loss.
Colorless:	36.6	32.5	1.9	23.9	2.7
Yellow:	38.3	31.9	4.4	23.5	2.7

——*Pleonektite* occurs with *arseniopleite* in the gangue of the manganese mine, Sjögrufvan, Grythyttan Parish, Örebro, Sweden. It is a light gray mineral,[16] with a hardness of 4, and a metallic fatty lustre. It is

[13] Ib., p. 201.

[14] Geol. För. Förh., XI., 1889, p. 212.

[15] Bull. Soc. Franç de Min., 1889, p. 327.

[16] Ingelström: *Neues Jahrb. f. Min.*, etc., 1889, II., p. 40.

transparent in thin splinters. Before the blowpipe it decrepitates, but does not fuse. On charcoal it gives the reactions for lead, antimony, arsenic, traces of manganese and water. It is probably a lead antimony arseniate resembling *hedyphane.*——*Anthocroite.*—When the ore from the Jakobsberg braunite mine is treated with hydrochloric acid, there is left as a residue a violet sand composed of little grains of a mineral that occurs scattered throughout the ore as well as throughout all the minerals associated with the ore, and in veins cutting the surrounding limestone. The largest masses of the mineral are in a magnese *vesuvianite*, and from this it can be obtained in a pure form. Lumps of the new mineral [17] consist of small transparent grains of a light amethyst color, and a hardness of 5–6. It is biaxial, with an optical angle (in air) of about 100°. Its analysis shows it to be a bisilicate with the composition :

SiO_2	MnO	CaO	MgO	Al_2O_3. Fe_2O_3	$K_2O.Na_2O$
51.6	3.4	23.3	13.5	1.4	6.8

——*Michel-lévyite* is the monoclinic form of barium sulphate, of which *barite* is the orthorhombic form. It was discovered by Lacroix [18] in the crystallized limestone of Templeton, Canada. It is a flaky, white substance, with three cleavages. These are assumed as the three pinacoids, giving 77°–78° as the value of β. The plane of the optical axes is perpendicular to $\infty \bar{P}\infty$, and the value of the optical angle is nearly 90° The principal bisectrix probably coincides with the axis *b*. Specific gravity=4.39.——*Messelite* is found in aggregates of colorless or brown tabular crystals in a clay slate at Messel, a station on the railroad between Darmstadt and Aschaffenberg, Hessen. The crystals [19] are monoclinic, with an extinction of 20° on the clinopinacoid. Their average percentage composition corresponds to the formula $(Ca\ Fe\ Mg)_3\ (PO_4)_2 + 2\frac{1}{2}H_2O$.——*Wiluite* is the name given by *Prendel* [20] to a variety of *vesuvianite* from Wilui, Russia. Its composition is :

SiO_2	TiO_2	Al_2O_3	CaO	MgO	Fe_2O_3.FeO	MnO	Alk	Loss
38.30	1.09	13.07	35.92	5.83	4.25	tr.	.37	.96

Crystals cut parallel to a prismatic face show the hour-glass structure in which the two constituent substances have different refractive indices. In sections parallel to the base the inner substances show a bi-

[17] Ib., p. 36.

[18] *Comptes Rendus*, CVIII., 1889, p. 1126.

[19] Muthman : *Zeits. f. Kryst.*, XVII., 1889, p. 93.

[20] Ib., p. 94.

axial interference figure with an optical angle of 3°–4°, while in the exterior zone the axial angle is 30°–35°. In both substances the axial figure is decreased by heating. Their hardness is above .7, and their specific gravity, 3.331. Their conductivity for heat is greatest in the direction of the *c* axis.——Three new *cupro-descloizites* are described and analyzed by Hillebrand.[21] The first occurs massive in the Mayflower Mine, Beaverhead county, Montana, in lumps of a dull yellow to pale orange color. The second is found as thick botryoidal incrustations in quartz, with a dull green color on the surface, and a brown color on a fresh fracture. It is found at the Lucky Cuss Mine, Tombstone, Arizona. The third came from the Commercial Mine, Georgetown, New Mexico, where it also is found as an incrustation on *quartz.* It varies in color from yellow through all shades of orange red to deep reddish-brown. The incrustations are distinctly crystalline, being made up of globular masses composed of little flat crystals crowded close together. At other times the incrustation is acicular in shape, when it appears to have formed on bunches of radiating *vanadinite* needles. The composition of this variety is:

PbO	CuO	FeO	ZnO	V_2O_5	As_2O_5	P_2O_5	H_2O	Cl	SiO_2	CaO	MgO
56.01	1.05	.07	17.73	20.44	.94	.26	2.45	.04	1.01	.04	.03

BOTANY.

Uredinial Parasites.—From a practical standpoint as well as from a biological, uredinial parasites are exceedingly interesting. A specimen, or specimens rather, found in Dawes County, Nebraska, this summer (July 20), deserve, I think, special mention. An Æcidium on *Lygodesmia juncea* Don. (Æcidium compositarum Mart. var. lygodesmiæ Webber), was found very commonly. It was very destructive, frequently distorting whole plants, and, by partially stopping the growth above, giving them a somewhat depressed much branched appearance.

The avenger, however, was close at hand, entirely too close for the good of the Æcidium. Not in the form of man, with his multifarious external poison applications, but simply another little parasite on this parasite, wreaking vengence. It was the little *Tuberculina persicina* (Ditm.) Sacc., a plant closely allied to the smuts, found very rarely in

[21] *Amer. Jour. Sci.*, June, 1889, p. 434.

America. It was very destructive to the Æcidium, its smooth violet-colored spores completely filling up fully half the pseudoperidia and injuring many more, destroying and taking the place of the æcidiospores. It has been reported before from but one place in America, so far as I can learn,—from Oregon,—unless we consider, as Farlow has hinted (*Botanical Gazette*, 1885, page 245), that Synchytrium jonesii Pk. (Tuberculina jonesii Pk. Sacc.) is identical with it.

On the same specimens of Æcidium, another but more common parasite was also found,—*Darluca filum* (Biv.) Cast. This is not usually very destructive. Cases are found, however, in which it is. To *Uromyces junci* (Desm.) Tul. it is frequently very injurious. Specimens of the uredo of *Puccinia rubigo-vera* on wheat collected at Crete, Nebraska, in July, 1886, are much injured by it. Perhaps it is a much more injurious species than we are wont to suppose. We have nothing to fear from it, however, as we have from some of its hosts. If it is a common wheat-rust parasite, we on the contrary can heartily say, would that it were more common.—HERBERT J. WEBBER, *Lincoln, Nebraska.*

The Lichens of the Guinea Islands.—The lichens of the three islands of St. Thomas, Prince, and Capra, lying in the Gulf of Guinea, off the west coast of tropical Africa, have recently been treated by Nylander, in a little work of 54 pages (*Lichenes Insularum Guineensium*). A noticeable feature of the lichen flora of these islands is that while on St. Thomas Island the *Corticolæ* predominate, on Prince the *Saxicolæ* are much more common; also quite a number *Foliicolæ* are found on the former. This will give an idea of the nature of the land in the islands. Another feature important to American lichenologists, is that of the 129 species enumerated, about 40 are found in our own country, or about one-third of the species are common to both places. In this pamphlet Dr. Nylander seems to lay considerable stress on chemical reactions, especially that of sodium on the "gelatinous hymenium," as a means of determining species. The "observations" in the back part of the book contain considerable information regarding new species from various localities, that of most interest to us being observation six, containing descriptions of new species collected by Dr. Eckfeldt and W. W. Calkins, etc., principally in Florida.—THOS. A. WILLIAMS, *Lincoln, Nebraska.*

The Flora of Central Nebraska (Continued).—In climbing the bluffs we gathered specimens of *Fragaria vesca* L., and succeeded in disposing of quite a number of its elongated conical berries. On the

climb up we ate berries also of *Rubus strigosus* Michx., *Ribes aureum* Pursh., *R. floridum* L., and *R. rotundifolium* Michx. At the base of the bluff the common *Cystopteris fragilis* Bernh., grew. Near the top, in more open places, we discovered the western fern *Woodsia oregana* Eaton. At the top and also over the sand hills in numerous places the dwarf sand cherry *Prunus pumila* L. occurs very plentifully.

Along the bank of the river, just above the water's edge, we found rank growths of *Asplenium filix-fœmina* Bernh., and *Aspidium thelypteris* (L.) Swartz. Nowhere else in Nebraska have I seen such a luxuriant growth of ferns. I collected fronds of each fully two and a half feet high. This is the only place the former species is known to occur in Nebraska. About a mile further up the stream a low wet patch of ground of about two acres in extent is a perfect mat of ferns *Onoclea sensibilis* L., and *Aspidium thelypteris* (L.) Swartz.

The next morning we took a walk along the edge of the bluffs on the south side to investigate the flora and the fauna of the "blow-outs."[1] Here we made some excellent finds. Right in the "blow-outs," where almost nothing else grew, we found quite commonly bunches of *Redfieldia flexuosa* Vasey (Torr. Bull., July, 1887). Such a find pleased me, but think of finding also in the same place bunches of *Eragrostis tenuis* (Ell.) Gray. The former has heretofore been reported from Colorado and Canadian R., the latter from Texas and Arizona. Both were also found in Nebraska this summer near Valentine. Branches of *Muhlenbergia pungens* Thurb. were also common, and are found usually just at the edge of the "blow-outs," hanging over. *Astragalus pictus* Gray, var. *filifolius* Gray (bird-egg, I call it, from its beautifully mottled red or purple and white pods), also frequents the "blow-outs." These with *Lathyrus polymorphus* Nutt., *Psoralea lanceolata* Pursh., *Pentstemon cæruleus* Nutt., and sparingly *Munroa squarrosa* Porr., form at this place the principal and remarkable flora of the Dismal River "blow-outs."

On the hillsides, etc., patches of buffalo grass (*Buchloë dactyloides* Engelm.) frequently occur, and in one place a few stems of *Paspalum setaceum* Michx. were found. *Yucca angustifolia* Pursh. is scattered here and there all through this region, and almost every plant has its leaves more or less affected by *Kellermannia yuccigena* E. and E.

In the grass on a sandy hill another find of the trip was made, *Tylostoma angolense* Welw. and Curr. This until last year was known

[1] A "blow-out" is a crater-like cavity in the side of a sand hill. Within it is a mass of loose sand, bordered by grasses and other plants which grow upon its margin. It is supposed to be formed by the action of the wind.

to occur only in one place, so far as I can learn in Angolia, Africa. In the summer of 1887 Mr. Marsland, a student of the University of Nebraska, collected three specimens in Manitou, Colorado, and handed them to me for identification. Failing to determine the species satisfactorily, the specimens were referred to Mr. A. P. Morgan, who pronounced them *Tylostoma angolense.* Besides this stalked puff-ball specimens of *Bovista circumscissa* Berk. and Curt., *Secotium warnei* Peck, and *Lycoperdon fragile* Vitt , were found in the grass.

Descending into the valley on the road back I gathered specimens of *Clematis ligusticifolia* climbing over the underbrush. The leaves of this also were contorted and frequently almost destroyed by *Æcidium clematidis* D. C. In a pond two species of *Chara* were collected, *Chara coronata* A. Br. and *Chara*—(undetermined).

Circœa lutitiana, a common plant in eastern States, but not yet discovered in Eastern Nebraska, and not given by Coulter in his Rocky Mountain Botany, was noticed in a shaded nook. It has also been collected during the summer near Valentine. Specimens were also collected of *Euphorbia petaloidea* Engelm., *Monarda citriodora* Cerv., *Froelichia floridana* Moquin., *Ipomœa leptophylla* Torr., and *Asclepias verticillata* L., var *pumilla* Gray.

On the Middle Loup River, in the same county, and representing the same flora, we found in stagnant pools, *Ricia fluitans* L., *Utricularia minor* L., *Pediastrum angulatum* (Ehrb.) Menegh. and *Merismopedia violacea* (Breb.) Ktz., a little violet-colored plant that has not been known before to occur in America. It is distinguished from known American species by its smaller size and violet color. Specimens of *Triglochin maritimum* L., and *Commelyna virginica* L., were found in low places, but they are rather rare.—H. J. WEBBER, *Botanical Laboratory, University of Nebraska.*

Bailey's Studies of Carex.—The initial number of the *Memoirs of the Torrey Botanical Club* is devoted to an article by Professor L. H. Bailey, entitled, "Studies of the Types of Various Species of the Genus Carex." The purpose of the paper is well stated in the opening paragraph, which may well be reproduced here:

"An attempt has been made during the past year to see all the existing types of North American species of Carex. These types are widely scattered, largely in the Old World, and the whereabouts of many of them have been entirely unknown. Many of them had never been seen by a student of the genus since their publication, and there was reason to believe that some species which had been seen by

our earlier botanists have not been properly comprehended in the light of our fuller knowledge. The examination has proved that many of our catalogued species are fictitious, and that considerable changes in nomenclature must be made. However such radical changes are to be regretted, they are nevertheless unavoidable if priority of publication is to be considered; and there is the surety that in the future the changes must be very few. The very oldest types have been seen so far as they are known to exist, and almost every name which has been applied to North American species is accounted for and understood. It is, therefore, evident that any further changes in the names of our species must be almost entirely such as rest upon judgments of the systematic merits of accepted species and varieties."

Professor Bailey visited or had access to twenty-six important collections of carexes, twenty-one of which are in European herbaria. In his paper he upholds the use of the oldest published name or combination in every instance. He has given varietal names "only to those forms which assume a considerable degree of permanence under various conditions, and the combining of which would lead to confusion in the knowledge of the species." He has no sympathy "with that ultra refinement of classification which gives names to specimens rather than to species and their larger variations. Such refinements serve no useful purpose, and do not merit the name of science.

Eighty-four species are critically noticed in the paper, and the synonymy carefully determined. The notes under each species are of the greatest value to the student of this difficult genus, and will have to be carefully studied by every one who wishes to know what are the latest views as to the relationship of the many puzzling species.—CHARLES E. BESSEY.

ZOÖLOGY.

The Zoological Position of Palawan.—Mr. A. H. Everett, in a paper before the Zoölogical Society of London, contends that Palawan and the other islands intervening between Borneo and Mindoro form an integral part of the Bornean group, and do not belong to the Philippine group with which they are usually associated. His grounds are that they are connected with Borneo by a shallow submerged bank, and are separated from the Philippines by water over 500 feet in depth; the fauna also shows a marked preponderance of

Bornean over Philippine forms, and farther, that those which must be regarded as belonging to the latter group are more extensively modified than are those from Bornean sources.

Bahaman Sea Anemones.—In a beautifully illustrated paper (*Jour. Morphol.* III.), Dr. J. P. McMurrich describes the sea anemones of the Bahamas, using as a basis material which he collected while a student at the Johns Hopkins summer laboratory. Fourteen species in all were found, of which *Bunodes tæniatus* and *Auloctinia stelloides* are regarded as new. The descriptions of the species contain many comments upon the synonymy and numerous details of structure impossible to present in abstract. Dr. McMurrich, from a study of these forms, concludes that the Bahaman Actinarian fauna is much more closely allied to that of the Indo-Pacific than it is to that of the rest of the Atlantic, the similarity of many species to those of the Red Sea being remarkable. The occurrence of *Lebrunnea neglecta* in shallow water in the Bahamas is interesting, since the other members of the sub-tribe to which it belongs occur in the deep seas off the coast of Chili. Dr. McMurrich explains this by supposing (with Semper) that uniformity of temperature is of more importance than the absolute degree of heat and cold.

The Siphonophores.—Prof. Ernest Haeckel finds (*Jena. Zeitsch.* 1888, and Vol. XXVIII. of the Zoölogy of the Challenger Expedition) that the Siphonophores embrace two very distinct groups, which agree only in being hydroid colonies, the individuals of which must be regarded as Craspedote medusæ modified for special functious. These two groups are called Siphonanthæ and Disconanthæ. In the first are included the great majority of the species, the Disconanthæ including only Porpita telella, etc. In the Siphonanthæ the colony is to be regarded as a Craspedote medusa, from the proboscis of which have budded numerous other medusæ which have become specialised for their different functions. In the Disconanthæ we have a Craspedote medusa, with its central proboscis and its marginal tentacles. Instead, however, of secondary individuals budding from the proboscis, these arise from secondary probosces which bud later from the under side of the disc. This view, it will be seen, is intermediate between the two theories of the morphology of the Siphonophores. According to the first, each Siphonophore is to be regarded as a single medusa, the various organs—swimming bells, gonads, tentacles, etc.—being dislocated parts of this medusa duplicated by budding. The other view is that the Siphonophore is a medusoid colony, each of the appendages to be regarded as an (often modified) hydroid or medusa.

The Mesenteries in the Antipatharia.—At a recent meeting of the Royal Society of Edinburgh, Mr. George Brook described the structure of the radial septa or mesenteries in the Antipatheria. The usual directive pair of septa were found, but besides these traces of bilaterality were not seen, and their positions were not explicable on the usually received explanations, but on applying the law developed by Lacaze-Duthiers for the Hexactiniæ to the septa of the antipatharian polyps, and regarding the order of the formation in the one as comparable to their length in the other, order was at once introduced.

The Eyes of Limulus.—Mr. S. Watase has made a careful study of the structure and development of the lateral and central eyes of Limulus, a preliminary account of which appears in the Johns Hopkins *Circulars*, No. 70. The compound lateral eyes have a faceted cornea, each facet corresponding to a conical lens projecting from the inner surface. Surrounding each lens is an ommatidial pit consisting of a single layer of ectodermal cells. In the centre is an axial process of a gigantic ganglion cell, while around it are arranged the pigmented ommatidial cells, each of which secretes on its inner (central) surface a finely striated "rod." Each of these retinular cells is in connection with nerve fibres, while around it are elongate pigment cells developed from the ectoderm. Mr. Watase does not find the intrusive mesodermal pigment described by Messrs. Lancaster and Bowne. In connection with the development of the eyes there is a formation of a V-shaped groove, which later flattens out, forming a partial optic invagination. The optic nerves arise as fibres from the ectoderm cells of the outer wall of the groove. The median eyes are also described, but without diagrams it is not easy to follow the account either of structure or development. Apparently the dorsal ectoderm gives rise to the "vitreous body" or corneal hypodermis, while the retina is produced by an invagination of ectoderm from the central surface, which grows forward and upward to connect with the other elements. Mr. Watase does not attempt to account for this strange condition.

Note on the Feeding Habits of Cermatia forceps Raf.—From an observant public school teacher, Miss Kate Rondeau, of Golconda, Illinois, I have received an item of information concerning the feeding habits of *Cermatia forceps*, new to me and to the literature of the species, so far as I am acquainted with it.

This myriapod was quite abundant during one summer in Miss Rondeau's residence (upon one of the islands of the Ohio River), especially in the kitchen and dining room. It seemed to be strictly

nocturnal in its habits, coming out, however, freely by night in the lighted rooms. "I have seen a dozen or more," she says, "at one time, remaining motionless for perhaps half an hour, when suddenly one, with a quick movement of one of its many legs, would catch an unwary house-fly that approached too near. Sometimes this would be eaten immediately, but sometimes held in the foot until two or three more flies were caught. I have seen the Cermatia thus eating one fly while holding two or three others.

"Only the soft part of the body of the fly is eaten, the legs, wings, and head dropping to the floor. In the morning the table and floor were always specked with these remains, showing that the Cermatia was a very successful fly-catcher."

I identified the form to which these remarks apply, by her minute description and by her subsequent recognition of a figure.—S. A. FORBES.

The Scottish Fishing Board.—Among the various papers in the report of this board, which in its functions corresponds with our Commission of Fish and Fisheries, we notice that it is advised, in order to restore the lobster fishery to its former condition, that the limit of size of lobsters permitted to be sold be raised from 8 to 9 inches in length, and it is also proposed to attempt artificial hatching of lobsters. The paper is by Prof. Ewart and Mr. T. W. Fulton. Mr. Thomas Scott catalogues 230 species of Crustacea as occurring in the Firth of Forth. Red codfish has been causing trouble in Scotland. Here it was believed by Dr. Farlow to be caused by *Clathrocystis rosea-persina*, but, Dr. Edington, of the Scottish Board, ascribes it to *Bacillus rubescens*, also introduced with the salt.

Coluber obsoletus Say.—A fine specimen of *Coluber obsoletus* Say was obtained on Snake Hill, near Newburgh, Orange county, New York, during the summer of 1888.—JOHN I. NORTHROP.

Hesperiphona vespertuca.—About noon, December 12, 1889, I procured a specimen of this rare bird. It was feeding on the seeds of a maple in front of the University buildings. The specimen is a male, and in fine plumage. It was apparently alone, as no others have been seen as yet. The only authority I find for its identification in Ohio is Ohio Geological Report, Vol. IV., by J. M. Wheaton, p. 314, where he reports it was identified by Dr. Kirkland, March 24, 1860. The bird differs in a few details from most of the descriptions. A complete description will be given in next issue of Bulletin of Scien-

tific Laboratories. Dr. Wheaton states that the song of the evening grosbeak is a miserable failure. In Vol. I. of the Bulletin will be found a note on the song, and the complete osteology of the species, by Prof. C. L. Herrick, with plates.—W. G. TIGHT, *Denison University, Granville, O.*

Note on the Seventh Cervical Vertebra of the Cat.—While preparing a skeleton of a young cat, I was interested to note that the diapophyses of the seventh cervical vertebra were perforated for the passage of the vertebral artery and vein. Flower (Osteology of the Mammalia, p. 38) states that "the transverse process" (of the Carnivora) "has no inferior lamella, and its base is imperforate." Wilder, however (Anatomical Technology, p. 172), says that in the cat the last cervical vertebra is rarely perforated.—JOHN I. NORTHROP.

Zoological News.—Protozoa.—J. Künstler (*Comptes Renders*, 1888) has found a protozoan parasite resembling *Lophomonas blattarum* in the posterior part of the intestine of Limulus. In the same place he describes other entozoic protozoa from various hexapods.

Dr. Plate's observations on the luminosity of Noctiluca (*Ann. and Mag. Nat. Hist.*, 1889) are interesting. When specimens were placed on moist blotting-paper, and examined under a high power, he found that the character of the light varied. At times it consisted of sharp flashes followed by total darkness, or by a faint light for a minute or two. Again, the surface might be faintly luminous while at the same time small points sparkled brightly, or, lastly, the whole surface was luminous on account of such sparkling points. The light is produced by the outer layer of plasma, and is stimulated by irritation. Pure oxygen passed over the specimens produced a dull light visible for several minutes. In nitrogen no light is produced.

The most noticeable of Gruber's new species of Protozoa (*Bericht Naturfor. Gesellschaft Freiburg*, 1888) is a new Protomyxa, which differs from Haeckel's oft-quoted species, *P. aurantiaca*, in being colorless. Staining with picrocarmine brought out the fact that nuclear substance (chromatin) was actually present as small granules scattered through the protoplasm. The bearings of this upon the validity of the Monera is at once evident.

Crustacea.—Rev. A. M. Norman presents some notes on British Amphipods in the *Annals and Magazine of Natural History* for June. A new genus, *Megaluropus*, is described, and the synonymy of several species of *Œdiceridæ* is straightened out. In August he continues

with notes on Leucothoidæ, Pardaliscidæ, and Gammaridæ. The American *Gammarus ornatus* is shown to be the same as *G. locusta*, while there are notes on three other species which range to American seas.

Arthropoda.—Mr. Arthur Dendy reports (*Nature*, Feb. 14, 1889) the discovery of a new species of Peripatus in Victoria, Australia.

Albert D. Michael describes (*Jour. Roy. Micros. Soc.*, Feb., 1889) the anatomy of the mite *Uropoda krameri*. The paper is not one admitting of abstract. The general features of the species are Gamasid, but as in its shape it approaches the Bropodidæ, so it does in its structure.

Hexapoda.—According to the *Jour. Roy. Micros. Soc.* for December, Dr. D. Casagrande claims that in the silk-worm (in which he traced the metamorphosis of the alimentary canal from the larval to the adult stage) "the epithelium of the œsophagus and of the hind gut of the perfect insect is derived from the mid gut; in such a case the œsophageal and hind gut epithelium in the adult insect cannot be regarded as ectodermic in origin, as they are in the larva, but must be entodermic, arising as they do from the mid gut." The writer has recently shown (AM. NAT., XXII., p. 471, 1888, and more fully in a paper soon to be issued) that in Crangon the alimentary tract proper is wholly of ectodermal origin. Now no one has yet published any complete account of the development of the digestive tract in the Hexapods, but there is much reason for suspecting that in this group a similar condition of affairs exists. The observations of Dr. Casagrande are strongly confirmatory of this view, which, if it be true, relieves us from the necessity of replacing organs derived from one germ layer by cells derived from another.—J. S. KINGSLEY.

Vertebrata.—T. H. Morgan concludes (*J. H. U. Circ.*, No. 70) that in *Amblystoma punctatum* part of the blastopore is converted into the neurentric canal, and part persists as the anus, while in *Rana halecina* the blastopore completely closes.

The South American bat (*Noctilio leporinus*) is stated to eat fish. Specimens have recently been studied in which fish-scales were found in the stomach.

Mr. P. L. Sclater sends to *Nature*, No. 1012, the substance of a suggestion made by Mr. W. Rodier, of New South Wales, for the extermination of rabbits, which has at least the elements of plausibility. It is to catch as many of the rabbits as possible by means of traps,

ferrets, etc., and to destroy only the does taken, setting the males free. "The results of this mode of operation are that the male rabbits, as soon as they begin to predominate in numbers, persecute the females with their attentions, and prevent them from breeding. They also kill the young rabbits that happen to be born, and where they largely predominate in numbers, worry the remaining does to death." Mr. Rodier states that on his station an eight months' trial has resulted in clearing the country of the pests.

Fishes.—Jenkins and Evermann describe (Proc. U. S. Nat. Mus., 1888) eighteen new species of fishes from Guaymas, on the Gulf of California. Hermosilla is a new genus of the family Sparidæ, and Pseuddoblennius of the family Blenniidæ. Clevelandia is reduced to synonymy as was done some time ago in this Journal.

Dr. R. W. Shufeldt (*Jour. Morphology*, II., pt. 2) has given some details of the osteology of an unique specimen of the fish *Grammicolepis brachiusculus* Poey. The account is too detailed for abstract, but with Professor Poey, Dr. Shufeldt thinks the relationships of the Grammolepidæ tend mostly in the direction of the Casangidæ.

Birds.—Mr. F. E. Beddard concludes (*Proc. Zoöl. Soc.*, London), from a study of the muscular system of Polyboroidei, that this genus is not even an aberrant type of Falconidæ, and does not deserve even sub-family rank.

EMBRYOLOGY.

A Physiological Hypothesis of Heredity and Variation.—The extravagant claims made by Prof. Weismann, the author of the doctrine of the *isolation of the germ-plasma*, and of the doctrine of *heredity* based upon it, as well as the strenuousness with which it is insisted that there is no other way in which the facts of inheritance may be coördinated, requires that a re-examination be made of the grounds upon which those claims are supposed to rest. This is all the more necessary, in that this author and his followers repudiate the evidence upon which the claim is made that acquired characters, taken in the widest Lamarckian sense, can be transmitted. During a period extending over fifteen years the present writer has devoted himself to a study of the genesis of adaptations, and with the lapse of time the conviction has grown only the clearer that these authors are laboring

under a delusion. The way in which they have placed themselves upon record shows that they have not reckoned with the consequences of their reckless speculations.

In the first place, the supposition of a germ-plasma distinct from the plasma of the parent-body is a needless interjection into the machinery of hypothesis of biological evolution. It does not make the matter one whit clearer to suppose that the germ-plasma is necessary, than to suppose that *all of the living plasma of any and every distinct species is an idioplasm, or is specific in so far as that species is concerned.* If we now suppose, as a consequence of the action of the principle of physiological division of labor, first propounded by H. Milne-Edwards, that *all the plasma, or the whole of the specific protoplasm or idioplasm of the organism, becomes physiologically differentiated and incapable of undergoing embryonic development, except that of the germ-cells or germinal plasma*, as long ago urged by Professor Huxley, we get the same result as that reached by Weismann without involving ourselves in the consequences which beset his hypothesis. *This germinal matter is the only functionless and idle plasma in the parent body*, capable of growing and consequently of multiplying its cellular units within the parental organism at the expense of the surplus metabolism of the latter as a whole. Moreover, the germinal cells are alone capable of detaching themselves, or being detached, from the parental organism as products of over-nutrition, which have become useless to the life of the parent, as assumed in my preliminary paper "On the origin and meaning of sex." This recognizes the apparent fact of the setting aside or isolation of the germ-plasma, but does not make that fact the cause of the stability of species through the continuity of processes of growth, and the assumed but not empirically demonstrated isolation of such germ-plasma. My interpretation is in absolute accord with the requirements of the principles of modern physiology, while the hypothesis of Weismann and his followers is in conflict with those principles, and ultimately, as a necessary consequence, with the still more comprehensive principle of the conservation of energy. Modern physiology, as well as the doctrine of the conservation of energy, positively forbids us to interpose any barrier between the plasma of the parent-body and that of the germ-cells, as is done by the promulgators of the hypothesis of the continuity and isolation of the germ-plasma. To do so robs us of the possibility of appealing to the agency of the workings of metabolism as the efficient causes of the modification of the germinal matter. Since metabolism, and all that it implies, is the only agent to which, according to modern physiology,

we can appeal, without interjecting gemmules, plastidules, pangens or some other accessory and needless agency into living organisms, as the efficient agents in the transmission of hereditary traits, we are restricted in our choice to metabolism alone. In this way only is it possible to get rid of a *deus ex machina* in the form of an idioplasm in the sense first implied by Nägeli, or of the gemmules of Darwin and Brooks, the plastidules of Haeckel, the pangens of De Vries, or the physiological units of H. Spencer.

The preceding paragraph contains, in essence, my own hypothesis according to which all the facts of hereditary transmission and variation may be coördinated without losing or rendering unavailable the advantages which may be derived from the supposition that acquired characters may be transmitted.

On my view metabolism itself becomes the means of transmitting the changes in the adult organism, due to the complex interaction between it and its surroundings to the idle, functionless and passive germ-cells, because it is a demonstrable fact that these are the only cells in a multicellular organism which have no work to perform which is of direct benefit to the individual life of that organism, unless it may be to take up the surplus nutriment not used up by the metabolism of the parent-body in the secular exhibition of the sum total of its physiological energies, in the struggle for existence.

On my view the idioplasmic or specific molecular character of the plasma of the germ-cells, in common with that of the protoplasm of the whole body (which latter always tends to repair injuries, or even, in lower forms, replace lost parts), tends, in virtue of its acquired specific traits, to repeat the organization of its parent type, in the course of its development, not because it is something different from the protoplasm of the cells of the rest of the body, but because it is wholly unspecialized and without physiological differentiation, as first urged by Prof. Huxley and subsequently maintained by H. Spencer. Molecular impressions experienced in the course of variations in the modes of manifestation of or disturbances of the balance of the metabolism of the parent-body are supposed upon this view to be transmitted as molecular tendencies to the idle or passive plasma of the germ-cells. Variations in the molecular constitution and tendencies of the germinal matter are supposed to thus arise at different times in the same parent, and that, consequently, successive germs may be thus differently impressed. In this way also the molecular tendencies of the plasma of the germ-cells of different individuals may be also modified simultaneously or successively through the effect of enforced changes in the metabolism of multitudes

of contemporaneons adult individuals of the same species, thus leading to a tendency toward concurrent or simultaneous variation of offspring in the same or a similar direction.

It will be seen that this is the only hypothesis which renders the possibility of concurrent or simultaneous variation within the limits of a species either conceivable or intelligible. It also lends itself to an intelligible comprehension of the phenomena of the correlation of the growth of parts, and it is also the only view which holds out any promise of coördination with the highly ingenious and suggestive hypotheses of Prof. Wilhelm Roux.[1]

It will be at once perceived that my hypothesis of the acquisition of variations and their transmission is the simplest that has yet been offered. It interjects nothing hypothetical into our conception of the physical substratum of living organisms, except the necessarily unknown and unknowable constitution of the molecular factors of metabolism, already assumed by all scientific physiologists, all of whose conceptions of living processes are based upon the theory of metabolism, and thus brought into harmony with the all-inclusive doctrine of the conservation of energy. Growth and development without accompanying metabolism is simply unthinkable. All of the tendencies, capabilities and manifestations of growth in all living organisms are coëxtensive with and the concomitants of metabolism. From this conclusion there is no possible means of escape. To imagine the existence in living bodies of a hypothetical entity for the sole and express purpose of superintending and ordering the sequence and modes of action of the processes of development is, to the mind of one who is imbued with the true scientific spirit, no better than an appeal to "vitality" to explain the sequence and nature of the phenomena of life. Such methods in biological science ought to have received their quietus from Huxley's suggestive and witty comparison of the "vitality" of an organism with the "horology" of a clock.

That a certain habit of metabolism is inheritable is sufficiently attested by the notorious transmissibility of the tendency to obesity in the human race, since illustrations will immediately occur to almost every one of families in which the tendency is known to be hereditary. Similarly there is scarcely a possibility of doubt that the greatly increased fertility of domesticated races of animals and plants is almost exclusively due to a gradually increased power of appropriating nutriment due to a change in the molecular habit or mode of metabolism of the plasma of the body under better conditions of nourishment

[1] Der Kampf der Theile im Organismus. 8vo., pp. VII., 244, Leipzig, 1881.

which has been slowly augmented and fixed by inheritance.[2] Even certain species of fishes, when well fed and kept in confinement, not only spawn several times during a season, instead of only once, as I am informed by Dr. W. H. Wahl, but also when kept from hibernating, as he suggests, tend to vary in the most astounding manner. The wonderful results of Dr. Wahl, attained in the comparatively short period of six years, show what may be done in intensifying the monstrous variations of Japanese gold-fishes, through selection, confinement in tanks and aquaria, with comparatively limited room for swimming, plenty of food, etc., all of which conditions tend to favor growth and metabolism, and the expenditure of energy under such wholly new and restricted conditions as to render it almost certain, as he thinks, that these factors have something to do with the development of the enormous and abnormally lengthened pectoral, ventral, dorsal, double anal and caudal fins of his stock. Some of the races of these fishes have obviously been affected in appearance by abundant feeding, as is attested by their short, almost globular bodies, protuberant abdomens, and greedy habits, as I have observed in watching examples of this short-bodied race living in Dr. Wahl's aquaria. In these last instances we are brought face to face with modifications occurring in fishes under domestication which are infinitely in excess, morphologically speaking, of anything known amongst any other domesticated animals. That the abundant feeding and exposure to a uniform temperature during the whole year, and confinement in comparatively restricted quarters, has had something to do with the genesis of these variations, through an influence thus extended upon the metabolism affecting the growth of certain parts of the body, which have tended to become hereditary, there can scarcely be any doubt.[3]

That such changed conditions would also favor variability to a high degree we cannot doubt. That, moreover, the passive or idle plasma

[2] The only possible explanation of the phenomenon of the after-effect of the first impregnation of the viviparous female mammal upon all subsequent offspring by the male parent of such first offspring can be explained only upon the supposition that this singular effect is produced, as supposed by Sir W. Turner, through a permanent disturbance of the metabolic habit of the maternal organism by that offspring during the first uterine gestation.

[3] Since the foregoing was written, I have been able, through the helpful generosity of my friends, Mr. W. P. Seal and Dr. Wahl, who have supplied me with fresh material, to verify my suspicion that the muscular system of the highly modified races of Japanese gold-fishes is relatively much less well developed than in the usual and unmodified type found in open rivers. From careful dissections and measurements the evidence is conclusive that the muscular system has undergone marked degeneration and enfeeblement in the extremely modified domestic races, probably owing to disuse.

of the germ-cells would be thus impressed by changes in the manner of exhibition of the metabolism of the bodies of the parent fishes there can scarcely be any question.

In fact, if it is borne in mind that the extremely unspecialized and functionless condition of the germinal plasma is in itself favorable to variation through its impressibility by imperceptible changes in external conditions, we should almost cease to wonder at the variability of multicellular animals, which, as is well known, is always intensified under the influence of domestication.

It may not be generally known that abundant food and inappreciable variations of the conditions of life exert a most astonishing influence upon the size, form, rate of multiplication, and tendency toward conjugation in ciliated infusoria. The individuals differ in size by many times the bulk of the smallest condition of the same species, and there are equally great and unaccountable differences in form arising from unknown causes, as I learn by keeping the same colonies under prolonged observation, and no less than two very distinct and highly characteristic modes of fission may occur in the same species, whether free or attached in habit. So great are these differences that I am convinced that individuals of one and the same species have been regarded in some instances as distinct species by different observers who have not observed the same form under a great variety of conditions.

In an earlier essay,[4] giving synoptically the results of an extended study of the subject of sex, I assumed that the egg, or oösperm, was inherently more capable of variation in its early stages of development than during the later larval or adolescent period. This is what should have been expected if my hypothesis of the nature of heredity and the causes of variation is true, no less than upon the ground of the known want of morphological specialization characterizing all the germs of multicellular organisms. If we seek for facts in support of this view, we have them in abundance in the extreme sensitiveness of the ova of many metazoa to outward influences of the most trivial character. I may cite in illustration the well-known experiments of Weber in producing monstrosities from the recently fertilized eggs of the pike by simply shaking them somewhat roughly. To the same effect speaks the fact, well-known to fish-culturists, that the eggs of Salmonidæ immediately after fertilization must be handled with extreme care, some experienced persons declaring that it is even dangerous to disturb them in any way for the first few days, lest the

[4] Origin and Meaning of Sex. AMER. NATURALIST, pp. 501-508, Vol. XXIII., 1889.

greater part develop as double and variously deformed monsters. Such monstrous and worthless broods of larval salmon, which were doubtless the result of careless or ignorant treatment of the ova, I have myself seen. The same or similar facts are known to intelligent breeders of domesticated birds and fowls. And to this evidence it may be added that such monstrosities occur during development amongst invertebrates in a state of nature, as I have repeatedly observed in the case of the American lobster. The liability to deformities so produced is also known to diminish as development advances, thus firmly establishing, on the basis of fact, the view for which I contend. This also supports my conclusion, previously noted elsewhere, that the divergence of species must be studied from the stand-point that the tendency toward variation and divergence is most pronounced in the egg, and not in the adult, and in response to adaptive requirements to which the adult organism cannot so directly respond. This view further involves the conclusion that widely distinct forms, perhaps even phyla, have been directly evolved from the morula and planula stages as consequences of the greater capacity for direct adaptation possessed by germs in these stages, and that the earlier phases of segmentation are consequently far more significant than the later and more highly modified larval stages, all of which must be regarded as more or less directly adaptive, as a study of their structures and metamorphoses in relation to their surroundings renders self-evident, since many of them possess features which cannot be shown to have ever been of the least use to any conceivable ancestral form of the adult, as, for example, the placenta, amnion, and allantois, which are striking illustrations of this truth.

The father of modern transformism, Lamarck, was also one of the first to appreciate the significance of that foundation principle of modern physiology, which was named metabolism by Theodore Schwann. The further consequences of the differentiation of metabolic processes, *pari passu* with morphological differentiation were traced and elaborated as we have already seen by two great masters in biology, namely H. Milne-Edwards and Huxley, and it has been sought to show that a further consideration of the capabilities of metabolism indicates that it may become the foundation of an intelligible hypothesis of heredity, which takes as its logically necessary basis the assumption that there is no scientific warrant for the belief in the isolation of the germinal matter of living bodies in such wise that it is out of the range of the influence of the effects of the physiological activity of the whole parent organism. This must be so on the ground of the universality

of the occurrence of metabolism, even during the maturation or or growth of germs in the parent body, the contrary opinion being in conflict with fact.

The Lamarckian philosophy of transformism therefore offers the foregoing hypothesis of heredity as a substitute for the preposterous one of the isolation of germ-plasma, which, as here shown, is in the most obvious conflict with the principle of the conservation of energy. An isolated germ-plasma is as undemonstrable as the presence of bow-legged goblins in the moon. The primary postulate of that hypothesis is suicidal. There is no middle course to be taken. Biologists who commit themselves to an acceptance of the biological vagaries of Weismann array themselves against the modern rigorously scientific tendency to examine the problems of biology from the standpoint of the physicist.

In that the doctrine of the isolation of the germ-plasma is in irreconcilable conflict with the great cardinal principle upon which the whole fabric of modern physiological science rears its stately proportions, namely, with the general theory of metabolism, and, consequently, with the still more imposing and universal principle of the conservation of energy, we therefore realize what a colossal fabric of speculative rubbish must be consigned to the limbo of untenable and forgotten hypotheses in what is represented by the misguided labors af the advocates of the existence of an unalterable germ-plasma.—JOHN A. RYDER.

PHYSIOLOGY.

An Experimental Investigation of Strychnine Poisoning.—It is a known fact that certain organs extract certain substances from the blood. The kidney, for instance, takes up urea; the motor nerves have an elective affinity for curare, the nervous system for lead, etc. As regards any drug which particularly affects any organ, the question may arise whether the organ is affected because of a special attraction for the drug or because of a special susceptibility to its action. For example, does strychnine affect the spinal cord because the latter stores up a relatively larger quantity of it than other organs, or is the spinal cord more susceptible to its influence than is muscle, or liver, for instance? In order to throw light upon this subject, Dr. Lovett[1] has

[1] *Journal of Physiology*, Vol. IX., p. 99.

studied experimentally in the Harvard Physiological Laboratory the action of strychnine upon frogs.

A quantitative table was first constructed showing the time that various amounts of strychnine require to produce convulsions in frogs of known weight. A certain amount of a solution of strychnine sulphate was then injected into a frog, and after a stated time various organs, spinal cord, muscle, liver, brain, blood, etc., were removed and rubbed up with water to a fluid consistency. Given quantities of each of these were then injected into separate frogs, and from the time of the appearance of the convulsions, by comparison with the quantitative table, the relative amounts of the drug absorbed by the various organs of the first frog were calculated. The results go to show that the spinal cord takes up relatively more strychnine than any other organ. In the case of one frog—a typical one—the relative amounts of the drug in one gram of several organs were as follows: spinal cord, 1.52 mgr.; liver, .325 mgr.; muscle, .377 mgr. On comparing the relative amounts in the blood and cord it was found that after small doses the cord contained more than the blood, while the reverse obtained with large doses. This relation seems to be constant. From these experiments the question of the affinity of the spinal cord for strychnine seems to be answered most clearly. The susceptibility of its protoplasm to the drug is left undecided.—L. GOFF.

The Muscle Current.—Dr. R. Nicolaides, of the University of Athens, gives[1] the results of some observations with the capillary electrometer to determine the duration and law of disappearance of the muscle current. He finds that in the excised gracilis or sartorius of the frog the current falls away at first quickly, then more slowly, and very gradually disappears. The whole duration naturally varies, but is considerable, *e.g.*, 380 minutes (gracilis). The longitudinal section currents are very weak, and of shorter duration than those between longitudinal and transverse sections. His results show that the muscle current runs a course parallel to that of the muscle irritability, lasting as long as it lasts, and disappearing according to the same law as it disappears.—L. GOFF.

Effect of Atropin on the Chorda Tympani.—The two kinds of secretory fibres distinguished by Heidenhain in gland nerves have for some time enjoyed an undisputed right to existence. It has been recognized that there are "secretory" fibres, controlling the secretion of water and salts, and "trophic" fibres, controlling the elaboration

[1] Du Bois Reymond's *Archiv.*, 1889, p. 73.

of organic matter. It has, moreover, been suggested by Langley[1] that we must assume a third kind of fibre, which he calls "anabolic," to account for the formation of fresh substance in the gland cells. More recently, however, Langley[2] has studied the effect of atropin on the chorda tympani, and has obtained results which throw doubt on his own and Heidenhain's views. These results he sums up as follows:— "The various changes caused in the gland cells by nerve stimulation are all affected by atropin, and to approximately equal extents. When paralysis of the chorda occurs, it is a paralysis of the whole of its function with regard to the gland cells. In other words the phenomena of atropin poisoning give us indication of the existence of more than one kind of secretory nerve fibre in the chorda tympani." It should be observed that this last sentence puts the case too strongly. Langley's experiments indicate that the trophic and anabolic fibres may in some cases be paralyzed more completely than the secretory, though the degree of difference is slight; and the existence of the three kinds of fibres cannot yet be regarded as absolutely disproved.

Bayliss and Bradford,[3] who have worked on the electrical phenomena of the submaxillary gland, assert that stimulation of the secretory fibres causes the hilus of the gland to become positive to the outer surface, and stimulation of the trophic fibres makes the outer surface positive to the hilus. Since the first current is abolished by atropin sooner than the second, the presumption is that the secretory fibres are paralyzed sooner than the trophic. Langley, however, thinks that the two currents are due to the preponderance of, first, *physical*, and second, *chemical* changes in the gland cells, and that therefore the electrical phenomena are not incompatible with his results.—MARY A. JOHNSON.

Secretion of Salts in Saliva.—The power of choice exercised by a gland in the selection of substances offered it by the blood is little understood. Novi[4] brings forward facts that bear in a general way upon this point in studying the chlorine (*i.e.*, NaCl) contents of the submaxillary saliva of the dog. He finds this to vary with two factors, viz.: the rate of secretion, and the amount of NaCl present in the blood. If the latter remain the same, increasing the rate of secre-

[1] *Journal of Physiology*, Vol. VI. p. 88.

[2] *Journal of Physiology*, Vol. IX., p. 55.

[3] *Proc. Roy. Soc.*, Vol. XL., p. 203, 1886.

[4] Du Bois Reymond's *Archiv.*, 1888, p. 403.

tion increases the percentage of Cl in the saliva, which confirms the results of Heidenhain and of Werther. Again, if the rate of secretion remain unchanged, increasing the quantity of NaCl in the blood, as by injection of a ten per cent. NaCl solution into the jugular vein, increases the Cl contents of the saliva. The Cl increase in the saliva is here more rapid than that of the blood. If both factors vary simultaneously, the results vary; but it seems that a moderate change in the NaCl contents of the blood can overcome a considerable change in the rate of secretion. The percentage of NaCl in the saliva reached as high as .627, but never equaled that of the blood.

Langley and Fletcher in a paper presented to the Royal Society, and not yet printed,[1] while in general confirming the results of Novi, make a study of numerous other influences affecting the secretion of salts, such as dyspnœa, clamping the carotid, bleeding, pilocarpine, atropin, lithium citrate, potassium iodide and potassium ferrocyanide. "The general result of these experiments is to show that the secretion of water, of salts, and of organic substances are differently affected by different conditions, and that the percentage composition of saliva is determined by the strength of the stimulus, by the character of the blood, and by the amount of blood supplied to the gland. All, or nearly all, the arguments which have been adduced to prove that the secretion of organic substance is governed by special nerve-fibres, have their counterparts with regard to the secretion of salts, so that we might imagine at least three kinds of secretory fibres to be present. The experiments, on the whole, indicate that this complicated arrangement does not exist, but that the stimulation of a single kind of nerve-fibre produces varying effects according to the varying conditions of the gland cells."

[1] See abstract in *Proceedings of Royal Society*, Vol. XLV., No. 273, p. 16.

ANTHROPOLOGY AND ETHNOLOGY.

The Discovery of the Pool of Bethesda, Jerusalem.—Until a comparatively recent date the large reservoir known as Birket Israel, immediately beneath the north wall of the Temple Enclosure (Mosque of Omar), and a few paces inside of St. Stephen's Gate, has been accepted generally as the Pool of Bethesda. This, for a long period, has not been supplied with water, unless during the "rainy season," when a small pool may occasionally collect at the bottom. Also, it is fast being filled with rubbish by the Turkish authorities, and will soon disappear from sight. There were many discrepancies connected with the place, however, which forbade the more critical from being satisfied that it was the correct site.

Meanwhile, the discoveries in the ruins adjoining and northwest of the old Crusader Church of St. Ann, which stands a short distance to the northward of the Birket Israel, have gradually established the fact that the true site of the Bethesda is not the Birket Israel, but is beneath the ruins which, for centuries buried in rubbish, are still partly built over by the comparatively modern houses of the Moslems; for this is in the Mohammedan quarter of Jerusalem. Some few years ago, excavations brought to light a crypt beneath the remains of an old church or chapel constituting a principal part of the ruins; and beneath this, again, a large cistern-like chamber cut in the rock and decked over with solid masonry. In this reservoir water collected during the periodical rains, and many considered the evidence already sufficient to prove it the Bethesda.

Subsequent explorations have revealed the remains of two tiers of five-arched porches, the upper tier in the crypt, the lower in the pool. And the intelligent labors of the Algerine Monks, who are in charge of the property, have been further rewarded recently by the recovery of another pool, to the westward of that first discovered, containing a good supply of water; the entire agreeing with the descriptions of the Bethesda as given by the Fathers of the Church and Christian pilgrims and writers as early as the fourth century.

The correspondence of the five-arched porches to those mentioned in the gospel of St. John (v., 2.) will not escape notice. The remains of the upper porches extend above the pool at right angles from the north wall of the crypt beneath the church, in which the apse, at the east end, though dilapidated, is still distinctly defined.

The rubbish which has been removed contained a number of interesting antiquities, including Jewish and Roman coins, and fragments

of carved marble; while lower down were found pieces of ancient pottery and glass, the latter partly decayed and iridescent, together with broken icons, images or idols, in *terra cotta*, one being the upper portion (from the head to the waist) of a figure of Ashtaroth, the goddess of that serene people, the Zidonians. This was in the red burnt clay similar to that of the Moabite idols.

The work of excavating being continued, on clearing away the *débris* that choked the fifth arch or porch westward of the apse, in the crypt beneath the church already mentioned, the remains of a painting or fresco were revealed upon the plaster of the wall in the rear. This discovery was made just before Easter, or about April 18, 1889. The fresco represents an angel, as if descending into and troubling the water, which latter is depicted by conventional, zigzag, and wavy lines of an olive-green shaded with black, more suggestive of Egyptian hieroglyphics than of modern art, and surrounding the figure on every side. The right hand of the angel was shown as uplifted; but this has been carefully destroyed, probably by the Moslems (after their manner) in the early days of their power. So also the face of the angel, which has been battered so as to be completely obliterated. The glory or nimbus above the head, painted an orange-yellow, still remains, but little injured. The edge of the pool appears to be indicated by a broad red line enclosing the painting, and having an occasional rectangular projection into the water, perhaps representing steps, or the piers for the porches. On the east side of this fifth barreled arch (the wall extending at right angles) are the remains of another figure, also in fresco, much defaced, and supposed to represent the Saviour. Above the head, evidently intentionally mutilated, is a portion of the nimbus, and, in the lower outer corner of the painting, part of a blue robe.

It is to be regretted that these frescoes, the colors of which were quite bright when first uncovered, have since greatly faded, so that the blue is now a dull ashy gray. The reds and yellows, though lowered in tone, preserve their hues somewhat better, however.

To recapitulate: It will be perceived from my brief account that the remains described consist of four tiers of structure. First, the Turkish houses built upon the rubbish covering the ruins; next, the small church with apse; beneath this, the crypt with five porches, containing the frescoes; and fourth and last, underneath all, the pool itself, cut in the solid rock, and with five arches of well-preserved masonry. This last, from the historical and other evidence, I have not the slightest doubt is the *Piscina Probatica*—the veritable Pool of Bethesda.—HENRY GILLMAN, *Jerusalem, Palestine, April 24, '89.*

MICROSCOPY.[1]

Certain Improvements in Born's Method of Reconstructing Objects from Serial Sections.—The original method of Dr. Born was treated with considerable detail in Vol. XVIII., 1884, of the NATURALIST; since which time several improvements have been effected, descriptions of which have appeared from time to time. We take the following from a recent number of the *Zeitsch. für Wiss. Mikr.*, Vol. V., 1888.

The block of paraffine holding the carefully imbedded object should be cut into as perfect a prison as possible, the use of special instruments for this process being recommended. It is further advised that one of the faces at right angles to the plane of the knife should be marked in such a way as to leave no question as to its identity when the sections are cut. This marking may be brought about by the use of scoring, the lines being filled with coloring matter, and then covered in the ordinary way by dipping in warm paraffine.

The sections should have a thickness of about 1-50 mm., and the paraffine should be so prepared that it will not crush or crack before the edge of the knife.

The finally mounted sections are placed under the microscope, and by means of a camera the outlines are drawn to scale on separate pieces of paper. The thickness of each section and the amount of increase in size of the camera drawing over the original being known, it is a simple matter to determine the desired relative thickness of the wax that is to be applied to the paper bearing the drawing.

The improved method of applying the wax is as follows:

A lithographer's stone having been brushed over with turpentine, the paper is evenly spread upon it, and a strip of metal of the desired thickness is placed along each side. Wax is now poured over the paper, and, by means of an iron roller, is pressed into a layer of equal thickness with parallel strips of metal, which at the same time support the roller and limit the spread of the wax. The thicknesses recommended for the plates are 0.4, 0.6, 0.8, 0.9, 1, 1.12, 1.5, 1.8 and 2. mm. Combinations of these will give a sufficient range of thicknesses to correspond with all ordinary sections.

After the plates have all been made the careful work of removing the surplus wax should be undertaken, the drawing on the attached paper directing the work. Finally the enlarged sections are stuck together in their proper order, the model resulting.

[1] Edited by C. O. Whitman, Clark University, Worcester, Mass.

Kastschenko's Apparatus.[1]—Apparatuses planned to assist in processes of plastic reconstruction have been devised by Dr. N. Kastschenko, which may be profitably used in preparing the paraffine block for ordinary ribbon cutting.

The original apparatus had for its object to pare down the sides of a paraffine block in such a way that some geometrical pattern might surround the object. This pattern or "definition line" was intended to facilitate the reproduction of the object in a magnified model from sections made.

From the author's point of view, of course it is important that the definition or boundary surfaces (which in a section of the object are seen as definition or boundary lines) should be perfectly parallel, or at any rate have a fixed and determined position. The apparatus which he advocates is intended to effect this. The two models were constructed for the Thomas-Jung and for the Spengel-Becker microtomes. They are shown in Figs. 1 and 2, their natural size. (Plate III.)

In Fig. 1 is shown the cutter or parer as constructed for the Thomas-Jung object-holder. It may, however, be fitted to any microtome with a cylindrical object-holder. Its construction is extremely simple. It consists of a stout ring *b*, the internal diameter of which is exactly equal to that of the object-holder. The ring is immovably united to the piece *a*, which in its turn is exactly like the paraffine cylinder which fits into the object-holder. In the ring is seen the binding screw *c*. The paraffine-holder *d*, which fits inside the ring, may be either solid or hollow.

The holes in *d* and *a* are for the purpose of turning round the apparatus. While the object is being pared down the part *a* is fixed firmly in the object-holder, and when the block has had its definition-surfaces thus prepared, it is removed from the cutter and fixed on the object-holder in such a way that it is cut in a direction perpendicular to the surfaces.

The second model (Fig. 2), represents an apparatus intended to be used in any ordinary object-holder, and is of such dimensions that movement in any direction when it is fixed in the clamp is possible. This "parer" fits into the apparatus *e*, which consists of two blocks of wood loosely united by short metal wires. The wooden holder of course fits into the clamp while the block is being shaved down. When the boundary surfaces have been satisfactorily adjusted to the paraffine block, the latter is removed from the "cutter" or parer, and inserted into the wooden holder wherein it is sectioned.

[1] From an abstract in the Journal of the Royal Mic. Society, February, 1889.

ENTOMOLOGY.[1]

Rectal Glands in Coleoptera.—While studying the histology of *Passalus coenutus* Fab., recently, I found in the alimentary canal, between the colon and rectum, a structure which I consider homologous with the similarly located rectal glands of other groups of insects.

The colon has six longitudinal rows of diverticula, each diverticulum being in depth about one-third of the diameter of the colon. It consists of a somewhat spiny chitinous layer. Next is the lumen, external to which is a layer of cubical epithelial cells. Next is a layer of circular muscle fibus, and, alternating with the six rows of diverticula, six bands of longitudinal muscle fibres.

The rectum has a lining of smooth chitin resting on an epithetial layer, the cells of which are slightly more calumnar than those of the colon or of the intervening structure. Then come scattered circular muscles and six bundles of longitudinal fibres.

The anterior end of the structure uniting the colon and rectum forms the posterior wall of the last diverticulum of each row. Rising towards the lumen proper, from the bottom of this diverticulum, the wall soon bends posteriorly, forming a sort of side pocket, then returns and completes the posterior side of the diverticulum. The wall now passes backward for a distance about equal to that of three diverticula, then turns outward and slightly forward forming a small groove around the tube. It then bends back, narrowing the diameter of the lumen and making this rather conical, then gradually widens and becomes modified to form the rectum.

The anterior of these two parts of the structure I shall term the cushion, and the posterior portion, the cone. In cross-section the cushion is seen to consist of six longitudinal ridges, each ridge continuing the line of a row of the diverticula of the colon. The chitin in the last of these is smooth, but when it bends and forms the inner face of the cushion it becomes thickly set with short blunt spines, which point backwards. There are no spines in the groove between the cushion and the cone, but they begin at the posterior edge of the groove, and continue from this point to the rectum.

In both cushion and cone the underlying epithelium is cubical and contains prominent nuclei. It shows no traces of a glandular function.

The muscles are greatly developed. At the anterior end of the cushion they pass from one side of a ridge to the other, and between

[1] This department is edited by Prof. J. H. Comstock, Cornell University, Ithaca, N. Y., to whom communications, books for notice, etc., should be sent.

the ridges the six longitudinal bands are continued from the colon. Passing back the muscles become oblique, and external to the groove they are entirely longitudinal. In the cone they are oblique, then circular, and near the rectum a few oblique ones again appear. External to the muscles is scattered connective tissue. Tracheas and nerve fibres enter and ramify in the structure.

The ridges which compose the cushion are quite marked anteriorly and have a central median groove. Posteriorly the ridges are less marked, the median grooves becoming as deep as those separating the ridges.

Both from its histology and its position I regard this structure as a true rectal gland. Its function, however, I believe to be that of a valve. Minot (Histology of the Locust) says that Chun's decision as to their function is only "a speculative opinion." In favor of their being valves we find the following facts:

1. They are the best developed, and the most alike in insects which feed on solid and quite innutritious food. In those forms with more concentrated or liquid food they vary greatly and may even be wanting.

2. Their structure is to be best explained by the assumption of a valvalar function. This explains the thick spiny chitinous lining and the remarkable development of the muscles.

3. Their location is explained by this assumption, for a valve at this point would serve to retain the food in the absorptive portions of the digestive track till all nutriment was extracted; then the combined action of the spines and of peristaltis of the muscles would pass the remainder on.

The rectal glands therefore would retain their primitive valvular function in those insects which have retained their primitive food habits. In the more highly differentiated forms, with concentrated food they become modified, serving other purposes or are rudimentary.—H. T. FERNALD.

EXPLANATION OF FIGURES, PLATES IV. AND V.

FIG. 1. Longitudinal section of the rectal gland of Passalus, x 50 (about). *C.* colon, *R.* rectum, *ch.* chitin layer, *cir. m.* circular muscle fibres, *cone* cone, *c. t.* connective tissue, *cush.* cushion, *ep.* epithelium, *l. m.* longitudinal muscle fibres, *tr.* trachea.

FIG. 2. Cross section along line *A B* of Fig. 1 x 90.

FIG. 3. Cross section along line *C D* of Fig. 1 x 90.

FIG. 4. Cross section along line *E F* of Fig. 1 x 90.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Meeting of Station Botanists.—The Association of American Agricultural Colleges and Experiment Stations held its last annual meeting on November 12–16, at Washington, D.C. Several of the botanists connected with the experiment stations were present and held separate meetings. During the convention some advantageous changes were made, one of which was the division of the Association into at least five committees as follows: Agriculture, Botany, Chemistry, Entomology, and Horticulture. The college presidents and station directors will probably also form its committees as they may see fit. The chemists have held separate meetings for years under the title of Official Chemists; the entomologists organized last summer at the Toronto meeting of the A. A. A. S., and the station horticulturists held a convention at Columbus last summer. Before the Washington meeting the botanists were not fully organized, but were prepared to pass upon a constitution, when the division of the Association into sections was made, thus providing for the special meetings so much desired by the station workers, but up to this time unrecognized by the controlling spirits of the Association.

Several of the station botanists while at the Toronto meeting of the A. A. A. S. found time to get together and talk over matters that most concerned them in their work. Dr. Beal was made chairman, and among other things the Washington meeting was planned for. The Secretary communicated with a large number of economic botanists, and had the time been more favorable there would have been a large attendance. Some of the wheel horses were much missed upon this account. However, as it was, some good meetings were held, but the best of all, the botanists are now organized, committees have been appointed, and it remains very largely with the workers themselves whether the succeeding meetings are successful.

Dr. Geo. Vasey, chairman for the first two sessions, presented a valuable report of the growth of Botanical Division of the Department of Agriculture. This branch of the public service has accumulated a vast amount of material that now offers unequaled facilities for the best kind of botanical work. Dr. Vasey expressed the hope that station botanists would avail themselves of the assistance the Botanical Division can render them. At the same time the several botanists can reciprocate in some measure by contributing collections and facts of

observation not otherwise in easy reach of the division. At the close of a lengthy and interesting discussion of this paper a committee was formed, which drafted the following resolution: The Station Botanists desire to express their hearty appreciation of the generous support afforded the Botanical Division of the Department of Agriculture, as is evidenced by the printing of the various bulletins of the Division, and the public ation of a Journal devoted to the special interests of Botanists, and in view of the unequaled facilities afforded by the large amount of botanical material accumulated in the Division available for the preparation of much needed monographs on important or difficult groups of plants, wish to urge upon the attention of the Secretary the desirability of prosecuting this special work, and its early publication, both in the interest of botanical science and for the direct assistance of station botanists.

A paper from Dr. W. J. Beal upon "The Province of the Botanist in the Experiment Station," was read by the Secretary. It was shown that many subjects fall quite naturally to two or more of a station staff. For example, cross-fertilization may be done by the horticutural agriculturist or botanist, but a knowledge of botany is needed in any case. Grass experiments are in one sense agricultural, but a botanist is needed to determine the species. It is without doubt the work of the botanist to both determine the nature of a fungus disease and experiment with remedies.

During a discussion upon the amount of teaching to be done by the station botanist, a paper by Dr. C. E. Bessey was read, showing that it was important for the station and college to hold close to each other. The advantages were mutual, for advanced students could at the same time do experimental work and learn how to conduct investigations. It was the prevailing sense of the meeting that only a few advanced students should be taught by the station botanist, and all large classes instructed by a college professor.

A paper was presented by Professor McCarthy upon Seed-testing, in which it was advocated that some uniform method should be adopted. To this end a committee was appointed to report at the next annual meeting of the Association. The last evening of the Convention, after organizing as a committee or section under the new order of things with Prof. S. M. Tracy as Chairman, was spent in individual reports of work done. Among others, Professors Galloway, Chester, Saunders, Thaxter, and Arthur thus reported. It is proposed to obtain similar information from all the station botanists in the country, and embody it in a bulletin for assistance in coöperative work, and a com-

mittee was appointed to prepare such a pamphlet, which it is hoped to issue through the office of experiment stations.—BYRON D. HALSTED, Secretary.

The Seventh Congress of the American Ornithologists' Union.—The seventh annual Congress of the American Ornithologists' Union convened at the American Museum of Natural History, on November 12th, and for the first time in the Union's history it was found necessary to extend the usual three-days session to four days, the Congress adjourning November 15th, to meet in Washington on the third Tuesday of November, 1890.

Each succeeding meeting of the Union has shown increased attendance, and the present was no exception, twenty active and thirty-two associate members being present. The active members who attended are as follows:

Dr. J. A. Allen, of the American Museum of Natural History; Charles F. Batchelder, of Cambridge, Mass.; William Brewster, of the Museum of Comparative Zoölogy; Frank M. Chapman, of the American Museum of Natural History; Charles B. Cary, of the Boston Society of Natural History; Dr. Elliot Coues, of Washington, D. C.; William Dutcher, Jonathan Dwight, Jr., L. S. Foster, all of New York City; Col. N. S. Goss, of Topeka, Kans.; Dr. George Bird Grinnell, George N. Lawrence, both of New York City; Dr. Edgar C. Mearns, U. S. A., of Fort Snelling, Minn.; Dr. C. Hart Merriam, of the Department of Agriculture; Dr. James C. Merrill, U. S. A.; Robert Ridgway, of the Smithsonian Institution; John H. Sage, of Portland, Conn.; George B. Sennett, of New York City; Dr. R. W. Shufeldt, U. S. A., Washington, D. C.; Gordon Trumbull, of Hartford, Conn. Among the attending associate members were: Egbert Bogg, of Utica, N. Y.; Dr. Louis B. Bishop, of New Haven, Conn.; W. A. Conklin, of the Central Park Menagerie, New York City; P. L. Jany, of the Smithsonian Institution; Robert B. Lawrence, of New York City; Leverett M. Loomis, of Chester, S. C.; Mrs. Olive Thorne Miller, of Brooklyn; T. S. Palmer, of Berkeley, Cal.; C. B. Riker, of South Orange, N. J.; Dr. W. C. Rives, of Newport, R. I.; Wendell Prime, of New York City; Witmer E. Stone, of Philadelphia; Dr. Spencer Trotter, of Swarthmore, Pa.; Ernest E. Thompson, of Toronto, Can., and Dr. Louis A. Zerega, of New York City,

The first day's session was devoted entirely to the transaction of business, including election of officers and members. Several amendments to the constitution were presented to be considered at the next

annual meeting; the most important relates to increasing the active membership. The present constitution admits only fifty members to this class, but since the formation of the union the study of ornithology has received such an impetus, and so many new and worthy candidates for honors have appeared on the field, that the originally restricted number of fifty necessarily excludes many earnest workers who are deserving of higher recognition than admission to associate membership implies.

The officers of the preceding year were re-elected, but Dr. Merriam, much to the regret of the Union, firmly declined his re-election as Secretary, a post he has filled since the organization of the Union, and Mr. J. H. Sage was unanimously elected to this office. There were eight applicants for the single vacancy in the active member list; the fortunate candidate being Dr. Arthur P. Chadbourne, of Cambridge, Mass.

Four Corresponding and eighty Associate members were added to the roll of the Union, which contains now nearly five hundred names.

The remaining three days of the session were almost entirely devoted to a consideration of the large number of papers presented to the Union, the titles of which are appended. Many of these papers will appear in the official organ of the Union, *The Link*, and it is not necessary to further allude to them here. Special attention, however, is directed to Dr. Allen's timely paper on the "Extent to which it is Profitable to recognize Geographical Variation among North American Bird," wherein the writer makes some most pregnant remarks on the present tendency of ornithologists to describe insufficiently differentiated forms; and to Dr. Merriam's remarks on the "San Francisco Mountain and Vicinity (Arizona) from the Faunal Standpoint." This paper, based on Dr. Merriam's field work during the past season, marks an epoch in the study of faunal areas, and the methods of observation and tabulation employed present vast opportunities for further work by all intelligent field naturalists.

During the session the visiting members were daily entertained at lunch by the Linnæan Society of New York City, and this pleasant social feature was by no means the least enjoyable of what proved to be the most successful congress of the Union.

The following papers were read:

1. Observations on the Avifauna of Arizona, by Edgar A. Mearns, M.D. 2. The Winter Distribution of the Bobolink (*Dolichonyx oryzivorus*), with Remarks on its Routes of Migration, by Frank N. Chapman. 3. On the Changes of Plumage in the Bobolink, by Frank M. Chapman. 4. To what extent is it profitable to recognize Geographical Variation among North American Birds? by J. A. Allen. 5. Birds that have

struck the Bartholdi Statue of Liberty, Bedloe's Island, New York Harbor;—A History, by Jonathan Dwight, Jr. 6. On the Forms of the *Thryothorus ludovicianus* group of Wrens, by J. A. Allen. 7. On the Eastern Forms of *Geothlypis trichas*, by Frank M. Chapman. 8. Observations on some of the Summer Birds of the Alpine Portions of Pickens County, South Carolina, by Leverett M. Loomis. 9. Notes upon *Coccothraustes vespertinus* as a Cage-bird, by R. W. Shufeldt, M.D. 10. Remarks on Waterhouse's "Index Generum Avium," by J. A. Allen. 11. Remarks on Dr. Blanchard's Report to the Congrès International de Zoologie, on a Code of Nomenclature, presented at the Paris Session, 1889, by J. A. Allen. 12. On Peculiarities of Coloration in the Woodpeckers of the Genus *Dryobates* from the Northwest Coast, by Frank M. Chapman. 13. Note on *Cyanocitta stelleri littoralis* Maynard, by Frank M. Chapman. 14. On the Western Form of the Warbling Vireo, by Edgar A. Mearns, M.D. 15. On Seasonal and Individual Variation in certain Flycatchers of the Genus *Elaenea*, by J. A. Allen. 16. Remarks on San Francisco Mountain and vicinity (Arizona) from the Faunal standpoint, by Dr. C. Hart Merriam. 17. Abundance of the Wild Pigeon in Central and Eastern New York in 1835, by Prof. R. W. Whitfield. (By invitation.) 18. On the Maximiliar Type of S. A. Birds in the American Museum of Natural History, by J. A. Allen. 19. On the Birds of the Straits of Mackinae, by J. Dwight, Jr. 20. Note on the First Capture of the Little Brown Crane in New England, by Wm. Brewster. 21. Note on the Occurrence of the Canada Jay in Massachusetts, by William Brewster. 22. On the Habits of some Orange County, Florida, Birds, by B. Mortimer. 23. On the Mottled Duck in Kansas, by N. S. Goss. 24. *Phalænoptilus nuttalli nitidus*, is it a valid Race? by N. S. Goss.

Indiana Academy of Science.—The Fifth Annual Meeting of the Indiana Academy of Science was called to order Monday morning, December 30, 1889, at 10 o'clock, in the rooms of the State Board of Agriculture, at Indianapolis, by President John C. Brauner. After the appointment of the usual committees, and the transaction of business, the reading of papers was begun. The following papers were presented:

Description of a new species of *Rhinoptera* from the Gulf of California.—By title.—B. W. Evermann and O. P. Jenkins.

Fishes in the Yellowstone Park.—David S. Jordan.

Notes upon the Economic Phases of Entomology and Ornithology.—C. W. Hargitt.

Observations on the Destruction of Birds by Storms.—A. W. Butler.

In the afternoon 16 members were elected. The following papers were then presented:

The Breeding Habits and Larval Stages of *Amblystoma microstomum*.—O. P. Hay.

Aquatic Respiration of the Amblystomas.—O. P. Hay.

The Life-History of *Chorophilus triseriatus*.—O. P. Hay.

On Sulphophenylpropionic Acid.—Chase Palmer.

Soap Analysis.—John F. Schnaible.

The State of the Crater of Kilauea in August, 1889.—O. P. Jenkins.

The Moraines of the Maumee Glacier.—C. R. Dryer.

Probable Future of Petroleum in S. W. Indiana.—C. A. Waldo.

Observations on the Lakes of Indiana.—C. R. Dryer.

Some Unusual Forms of Lime Carbonate Deposition.—U. F. Glick.

The Top of the Matterhorn.—David S. Jordan.

Stone Characters of Nyssa.—John M. Coulter.

"Snake Cactus."—John M. Coulter.

The National Herbarium.—John M. Coulter.

Incandescent Gas Lighting.—W. DeM. Hopper.

In the evening President Branner delivered his presidential address upon the subject, "The Education of a Geologist." Following this was given a paper on the proposed meeting of the American Association for the Advancement of Science at Indianapolis,—Amos W. Butler,—which led to a general discussion of the requirements to make the forthcoming meeting of the American Association a success. Much interest was shown by all the members, and special efforts will be made to insure the second Indianapolis a very enjoyable one.

Tuesday morning, Dec. 31, the Academy convened at 9 o'clock. The treasurer filed his report, which was approved, after which 7 new members were elected. The following paper was read in general session: "The Effects of Trusts," by Jeremiah W. Jenks. Following this it was decided by the Academy, owing to the number of papers to be presented, to have the sessions in two sections, one devoted to Chemistry, Physics, and Mathematics, presided over by Vice-President Campbell; the other to Botany, Zoology, and Geology, presided over by Vice-President Hay. The following papers were presented before the former:

Dangers of the electric circuit.—John L. Campbell.

Apparatus for the determination of power consumption in friction and the cutting of metals.—Thos. Gray.

Thomson's portable magnetostatic electrical measuring instruments of long range.—Thos. Gray.

On the determination of the elasticity constants of materials by the deflection method.—Thos. Gray.

Preliminary report on the changes in density of wires on stretching.—Thos. Gray and C. Leo Mees.

The use of two mirrors for the determination of co-efficient of expansion in solids.—C. Leo Mees.

Cause of periodicity in thermometers, as discussed by Prof. M. A. Rogers.—C. Leo Mees.

Vapor densities of the volatiles metallic "Halids."—P. S. Baker.

The carbohydrates of the sweet potato.—W. E. Stone.

Oxidation by means of the fixed alkaline hydrates.—P. S. Baker.

Action of chloroform on aluminum chloride.—P. S. Baker.

Specific reactions for the penta-glucoses.—W. E. Stone.

The "Perkins Synthesis."—P. S. Baker.

Atomic weight of oxygen.—W. A. Noyes.

The height of the atmosphere.—W. J. Spillman.

Magnetic permeability of nickel at low temperatures.—A. P. Carman.

The uses of infinity and zero in algebra.—Rufus L. Green.

The potable water-supply of the City of New York.—A. E. Phillips.

Before the section over which Vice-President Hay presided the following papers were presented:

Explorations of the U. S. Fish Commission in Colorado and Utah.—David S. Jordan.

Explorations of the U. S. Fish Commission Steamer Albatross in the Pacific Ocean.—Charles H. Gilbert.

Explorations of the U. S. Fish Commission in Missouri.—Frank M. Drew and Louis Rettger.

Preliminary notes on the fishes of the Sandwich Islands.—O. P. Jenkins.

Some notes on Indiana reptiles and batrachians.—A. W. Butler.

Some rare batrachians.—W. S. Blatchley.

Fishes of Putnam county.—O. P. Jenkins.

Some habits of the crayfish.—C. W. Hargitt.

The occurrence of the badger in Indiana.—Amos W. Butler.

Notes on some fishes from the west coast of Africa, collected by Carl Stecklemann.—O. P. Jenkins.

On certain species of the genus *Chorophilus*.—O. P. Hay.

Some Indiana mildews.—M. A. Brannon.

Variations in plants from unripe seeds.—J. C. Arthur.

In the afternoon the following papers were read in this section:

The plants of Putnam county.—D. T. McDougal.

The Compositæ of Vigo county.—W. S. Blatchley.

Some structures in Epiphegus.—E. M. Fisher.

Mycorhiza and Epiphegus.—John M. Coulter.

Some remarkable floral variations.—C. W. Hargitt.

Some stem characters in Compositæ.—Harry D. Seaton.

The Academy then went into general session. The following subjects were presented:

Distribution of Cornus.—John M. Coulter.

On some plants new to the State list.—W. S. Blatchley.

Method of embedding and staining delicate vegetable tissues.—Douglas H. Campbell.

Germination of the macrospores of Isoetes.—Douglas H. Campbell.

Determination of lower plant forms.—Stanley Coulter.

Forest trees of Indiana.—Stanley Coulter.

Morphology of Siphonophores.—Louis Rettger.

Notes on Indiana butterflies.—Albert J. Woolman.

Investigations on relation between the intensity of stimulus and reaction-time.—W. J. Bryan.

The glacial geology of the Irondequoit region.—C. R. Duyer.

Remarks on the remains of a giant beaver found near Winchester, Indiana.—Joseph Moore.

Cremation.—Wm. B. Clarke.

Most of the papers were read in full, but few by abstract or title, and the discussions were good.

The total number of papers presented was 73.

The following officers were elected for the ensuing year.

President—T. C. Mendenhall.

Vice-Presidents—O. P. Hay, J. L. Campbell, J. C. Arthur.

Secretary—A. W. Butler.

Treasurer—O. P. Jenkins.

The next meeting of the Academy will be held at Greencastle, Ind., at some time in the spring to be determined by the Executive Board.

American Geological Society.—The following papers were read at the Toronto Meeting of the American Geological Society, on Thursday, August 29th, 1889:

J. D. Dana.—Areas of Continental Progress in North America, and the Influence of those Areas on the Work Carried on in Them.

"Progress" is the progress in rock-making; the "Areas" are those into which the continent is naturally divided as regards geological progress; and the "Work" is that of all the dynamical agencies concerned in the making of the beds in the rock series, including the biological agencies.—30 min.

G. K. Gilbert.—The Strength of the Earth's Crust.

It is believed by many students of dynamic geology that a district gradually loaded by sediment subsides, and that a district unloaded by degradation undergoes elevation, the process being quasi-hydrostatic. Certain observations in the basin of Great Salt Lake indicate that such results do not follow loading and unloading when the quantities involved are less than a certain amount.—30 min.

D. Honeyman.—Glacial Geology of Cape Breton.—20 min.

E. O. Hovey.—Observations on some of the Trap Ridges of the East Haven Region, Conn.

After a general description of the local geology, the author discusses the contact phenomena between the trap and the sandstone; the theories as to the age of the dikes; concludes that several of the ridges are intrusions, not extrusions.—30 min.

J. F. Kemp.—Trap Dikes near Kennebunkport, Me.

In this paper the local geology is described, the relations between the dikes and adjacent rocks are given, and the author discusses the microscopic structure and chemical composition of the rocks.—20 min.

P. Neff.—The Sylvania Sand in Cuyahoga Co., Ohio.

The writer discusses the value of this sandstone as a producer of oil and gas; from its distribution, and that of the Borea Grit, he concludes that an anticlinal reaching above water-line existed in Cuyahoga County prior to the Lower Carboniferous.—11 min.

J. W. Spencer.—I. Characteristics of Ancient Shores in the Region of the Great Lakes.—33 min.

II. High Continental Elevation Preceding the Pleistocene Period.

III. Origin of Boulder Pavements and Fringes.—12 min.

C. D. Walcott.—Study of a Line of Displacement in the Grand Canon of the Colorado, Arizona.

A description is given and attention called to a conclusion resultant upon the study of a line of displacement, in which the throw of a fault of pre-Cambrian age was partially reversed by a movement in the later Palæozoic, and again in the same line during Tertiary time.

H. S. Williams.—"The Cuboidos Fauna" and the Principles of Determining Equivalency in Separate Regions of the Globe.—20 min.

A. Winchell.—Pre-Silurian Rocks in North America.

This memoir will probably be postponed until the December meeting.

I. LeConte.—On the Origin of Normal Faults and of the Structure of the Basin Region.

SCIENTIFIC NEWS.

The Natural History Museum, Florence.—Florence, magnificently rich in works of art, is by no means poor in scientific collections, since among its public museums are included not only a splendid archæological one in the Via Colorura, well provided with Egyptian curiosities, and containing what is probably the most complete collection of Etruscan remains to be found in Italy or in the world, but also a Musia di Storia Naturale, attached to a school founded by Victor Emmanuele for instruction in the Natural Sciences.

The last-named museum is strongest in a point which is one of the weakest in all our American museums—in anatomical preparations in wax, representing the leading features in animal structure from the infusoria to man. In other respects this museum, though well arranged and tolerably complete, has no very salient features. The articulates have several small rooms, none too well lighted; the stuffed mammals are not very prominent; birds and their nests fill a large, well-lighted hall; fishes and reptiles occupy two halls and a gallery; but the interest for one accustomed to such collections commences with the osteological specimens, and culminates with the extensive series of preparations exhibiting the soft parts.

After leaving the purely osteological section, the visitor reaches that devoted to the lower animals—if it is now allowable for any man to declare that the human species, with all its long history of culture and inheritance of intelligence, is superior to creatures the highest of which resemble him in bone and muscle. Prominent among the animal preparations are exceedingly large scale models of the radulæ of various gastropods, models of Lumbricus, Hirudo, and other worms, showing the internal structure; magnified infusoria, with sections of the same; a very complete set of the anatomy of the torpedo, especially of the electric organs; sectional models of sharks and bony fishes; a set showing the anatomy of the common fowl, male and female, the growth of the egg in the ovary and uterus, and its development into a chick; the anatomy of the cat, male and female; and that of the sheep.

The most complete portion of the collection of models is, however, that relating to human anatomy. The osteology, the splanchology, the digestive, circulatory, respiratory, lymphatic and generative systems are here exhibited in the fullest manner possible without actual dissection; and every organ connected with each of these systems is treated to several models, representing it in various positions or in

various states. The nervous system is, if possible, exemplified even more fully than the others. In each room complete figures, some erect, others recumbent, show the general appearance of the system of organs to which the room is devoted; while all around, in table cases, are placed a double series of models of the separate organs or parts. Thus around the hall devoted to the ligaments of the bones are grouped sections of the various articulations, while in the centre reposes a human figure with all articulations complete. Sections of the head at various levels, with vertical and partial sections, combined with others exposing portions of the face and neck, show the chief points of brain-structure, and the courses of the cranial nerves, including the various branches of the fifth, and Willis' accessory. Models of the arms, legs, back, pelvis, etc., show the limb and body muscles down to those of the various digits, the levator, ani, cremaster, etc. The muscles of jaws and face are shown in an extensive series of models. The general lymphatic system is exhibited by recumbent figures; the positions of the various viscera by several entire figures of both sexes, and many partial sections. The several senses are very thoroughly exemplified, as are many points of histological structure.

The entire museum, except one small private cabinet, is open free to both sexes and all ages every Tuesday, Thursday and Saturday, the authorities wisely judging that some knowledge of human structure is a proper and essential portion of the education of all young people. It is noticeable that young people, varying from mere children to twenty or twenty-five years of age, form the greater part of the visitors.—W. N. L.

Prizes to Biological Students.—From a desire to verify his own researches as to the causes of failing nutrition in aging organisms, the undersigned hereby offers three cash prizes of $175, $125 and $100 for the best three comparative demonstrations, by means of microscopical slides, of the blood capillaries in young and in aged tissues, canine or human.

By young tissues (canine) are meant tissues from animals between the ages of one and two years.

By aged tissues (canine) are meant tissues from animals not less than twelve years of age.

By young tissues (human) are meant tissues from subjects between the ages of ten and twenty years.

By aged tissues (human) are meant tissues from subjects not less than sixty-five years of age.

While a preference will be given to demonstrations from human tissues, it will be possible for work in canine tissues to take the first and, indeed, all of the prizes. But of two slides equally well done in all respects, one canine the other human, the latter will be given the preference. Canine tissues should be from large animals.

Twelve slides from young and twelve from aged tissues must be submitted by each competitor, together with a full description of the subjects, methods pursued, and every detail and circumstance which is likely to throw light upon, or account for any peculiarity. The slides are for comparison as to the condition of capillary circulation, the young with the old, and should be in numbered pairs, or groups from the same kind of tissue. The term tissue is used in a general sense, e. g., pulmonary tissue, hepatic tissue, renal tissue, osseous tissue, muscular tissue, nerve tissue, alimentary tissue, etc.

No particular schedule of methods for injection, or staining, will be insisted upon, and no more definite directions or explanations will be given.

The slides, carefully packed and boxed, together with descriptive manuscript, can be sent by mail.

It is stipulated that the demonstrations which receive the prizes, shall become the property of the subscriber, for publication. All others will be returned, if desired.

No pseudonyms required. Accompany slides, in every case, with (real) name and address. Unless of known reputation as a biologist, a reference is respectfully solicited.

Reservation: no reward will be made unless work of at least ordinary merit is submitted.

This offer is made on the first day of January, 1890, and will remain open until the twentieth day of August, 1890.

Slides and manuscript will be examined and receipted for as soon as received.

The prizes will be adjudged on the first day of October, 1890.

These nominal prizes are offered less in expectation of results from the money as an agent, than in the hope that the offer may furnish a *point d'appui* for really needed work. Besides professional observers and students, there are in the United States a large number of amateur microscopists of acute vision and undoubted talent, who are at present playing with microscopes, as with toys, merely to see curious or pretty things. The time has come to concentrate observation upon the one proper object of biology, viz., the renovation and prolongation of human life. Address C. A. STEPHENS' LABORATORY,

Norway Lake, Maine.

The British Association for the Advancement of Science will meet at Newcastle-on-Tyne, September 11-19, 1889. Prof. Flower is the general president, and the sections will have the following chairmen: Geology, Prof. James Geikie; biology, Prof. J. S. Burdon-Sanderson; geography, Colonel de Winton; anthropology, Sir W. Turner.

It is proposed to hold a Botanical Congress in Paris in the second half of August. The secretary of the committee of organization is M. P. Maury, 84 Rue de Grenelle, Paris. Among the subjects to be made prominent in the Congress is the Geographical Distribution of Plants.

Prof. Kinkenberg, of Jena, died in March. He was well-known for his researches on the physiology of the invertebrata.

Dr. James Beard, who has paid special attention to the development of the fish-like vertebrates, is to be associated with the Scottish Fishing Board.

Mr. J. Reynolds Vaizey, a young English botanist, whose publications have been in the line of the morphology of mosses, died recently at Cambridge, England, from injuries received from falling into a fire while in an epileptic fit.

Flora, the well-known German botanical journal, will hereafter be published at Marburg, under the editorship of Prof. Karl Gœbel.

Mr. Arthur E. Shipley has been appointed teacher of comparative anatomy for medical purposes in the University of Cambridge.

Dr. Heinrich Ernst Karl von Dechen, the well-known geologist, died at Borm, Germany, February 15th, 1889, aged 89 years.

The Rev. John G. Wood, the popular English author on natural history, died at Coventry, England, March 3d, 1889, in his sixty-second year.

The address of B. F. Lowne, as president of the Queckett Microscopical Club, is given in the Journal of the Club for April. It deals with the history of the morphology of insects.

Wassili Mkolaewitsch Ulianin, the well-known embryologist and professor of comparative anatomy and embryology in Warsaw, died February 5th, 1889, in his forty-ninth year.

The Legislature of Georgia has recently re-established the Geological Survey of the State. Prof. J. W. Spencer, of the State University, has been duly appointed to take charge of the work. Two assistants are authorized, besides the chemist and other specialists. Georgia has not been as derelict in its survey as appears, for in the forties a survey was organized. Again from 1876 to 1879, the survey was in progress, but the results have never been published. So this is the third survey.